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AN INDEX OF THE PHYSICAL VOLUME OF PRODUCTION

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III. MANUFACTURE, 1899–1919

Scope and Method

ANALYSIS of the physical volume of production discloses fundamental differences between agriculture, mining, and manufacture. These differences necessitate the development of three separate indices before any general index of the physical volume of production can be constructed. Indices for agriculture and mining have already been set up in Parts I and II of this study. Part III develops a similar index for manufacture. The unadjusted index is given in the present installment. In the December issue, the adjusted index of manufacture will be developed — Part III (continued) — together with a general index of the physical volume of production for all industries — Part IV — combining the separate indices for agriculture, mining, and manufacture.

The fundamental differences between agriculture, mining, and manufacture have already been examined.[2] While these differences are in general conspicuous and unmistakable, the precise line between manufacture upon the one hand, and agriculture and mining upon the other, is not easily drawn. Is the ginning of cotton an agricultural or manufacturing process? Is the churning of butter to be considered agriculture if done on the farm, and manufacture if carried on in a central creamery? Is the smelting of copper, the burning of lime, the production of cement, mining or manufacture? Such questions are complicated not only by the difficulties of recognizing accepted meanings and preserving logical consistencies, but by the character of existing industrial organizations and the limitations of established statistical services. If butter were produced solely on the farm it would almost certainly pass as an agricultural product; if it were produced solely in central creameries, it would almost as surely be considered a manufactured product. The decisive consideration appears to be the character of the producing organization rather than the nature of the technical processes employed. Thus if copper never emerges as a commercial product until the ore has been smelted, bar copper appears to be a product of mining, though the process of extracting the metal from the ore has all the technical characteristics of manufacture. Furthermore, if the statistical data on copper mining first issue in the shape of the records of smelter output rather than ore production at the mines, smelting is so inextricably enmeshed with mining as to become in the records an integral part of it. Here, as elsewhere, statistical analysis has to follow the lead of established reporting services, and accommodate itself to the nature of the available data.

Fortunately, difficulties can be somewhat reduced if the classification of a single competent authority can be followed throughout. In the present study such an authority is found in the United States Bureau of the Census. The census bulletins and reports observe with the utmost care a comprehensive scientific classification of economic activities. This census classification, so far as it relates to manufacture, has been followed in the present study. While difficulties of classification are not thereby altogether eliminated, they are materially reduced. Moreover, the merit of logical consistency is almost completely attained.

Serious as are the difficulties experienced in constructing indices of agriculture and mining, much more troublesome obstacles are encountered in setting up the corresponding index of manufacture. In the first place, production in manufacture assumes a much greater variety of form. Agriculture and mining turn out raw materials, and the important raw materials are relatively few in number. Furthermore, any one raw material is relatively homogeneous. In manufacture, the raw materials are wrought into an unlimited variety of forms to meet an infinite variety of wants. A small number of raw materials emerge finally as a large number of diverse finished products. Furthermore, products not previously manufactured, such as automobiles, washing machines, and numerous chemicals, are continually being developed. As a result, the difficulties of obtaining an adequate picture of the whole are greatly increased. The course of physical production in manufacture, instead of being observed directly in the records of output of a few selected commodities, has to be determined indirectly through analyses of the data of miscellaneous goods — sometimes of articles produced, sometimes of materials used. Furthermore, the index of the physical volume of production for manufacture has to be based upon a much less complete composite than are the indices for agriculture and mining. The latter rest upon series representing 85 per cent and 86 per cent respectively of the aggregate value of output in agriculture and mining in the United States. The index of manufacture has a narrower foundation. Probably about 40 or 45 per cent of manufacture is included in the index for census years. The manufacturing index is thus really only a first approximation to the result we should obtain were complete information available regarding the output of the infinite variety of manufactured products. It should be said, however, that the problem in hand is to construct indices of *relative* production, not to determine absolute totals, and all that is necessary is to secure adequate "samples." The samples for manufacture, as well as for agriculture and mining, appear to be fully adequate for this purpose.

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[1] Professor Persons, with the assistance of Eunice S. Coyle, contributes the section covering the census years (pp. 311–325).

[2] See p. 247 in Part I, The Review of Economic Statistics, September, 1920.

Partly because of the heterogeneity of the products of manufacture, partly for other reasons, data on the physical volume of production in manufacture over a period of years are much more seriously deficient than the corresponding data on agriculture and mining. Furthermore, the deficiencies are more rapidly cumulative as we go back in time. In constructing the indices of agriculture and mining it was possible to cover the entire period from 1879 to 1919. Inadequacies of data compel the restriction of the manufacturing index to a substantially briefer period. The index as constructed runs from 1899, the year of the Twelfth Decennial Census, to 1919, the year of the Fourteenth. Fortunately, even this shorter period covers practically all of the extraordinary business epoch inaugurated in the late nineties, and furnishes a long enough span for the measurement of existing trends and the construction of a reliable adjusted index of the volume of manufacture during recent years.

The deficiencies of annual data lead to an important modification of procedure in the construction of the manufacturing index. The indices for agriculture and mining were based entirely upon series of annual items. In the analysis of manufacturing output, it seems desirable to reinforce conclusions drawn from the annual items by results obtained from data of other sorts. The most complete records of manufacturing in the United States appear in the reports of the federal census of manufactures, taken every five years by the United States Bureau of the Census. In the construction of the manufacturing index, indices have been independently compiled from the census figures for the census years 1899, 1904, 1909, and 1914, and from the annual items for the years 1899 to 1919. Since the census data are more abundant than the annual, and the census index consequently more reliable, the index based upon annual items is corrected to conform to the census index for 1899, 1904, 1909, and 1914. The census index may be looked upon as a series of solid abutments by which the frailer continuous annual index is firmly supported. By this combination of census and annual data, all available material is made to contribute to the strength of the annual index of manufacture.

The index of manufacture, both for census years and annually, is built up by a process of integration — an orderly development of successively larger elements from smaller components. That manufacture exhibits important subdivisions is generally recognized. The Bureau of the Census presents, as the basis of its classification of manufacturing industries, the following groups of industrial products:

I. Food and kindred products
II. Textiles and their products
III. Iron and steel and their products
IV. Lumber and its remanufactures
V. Leather and its finished products
VI. Paper and printing
VII. Liquors and beverages
VIII. Chemicals and allied products
IX. Stone, clay, and glass products
X. Metals and metal products other than iron and steel
XI. Tobacco manufactures
XII. Vehicles for land transportation
XIII. Railroad repair shops
XIV. Miscellaneous industries

This classification is adopted in the present study. So far as the data permit, an index is set up for each group of manufacturing industries.

Just as manufacture in general is a combination of major groups, so each group is a combination of important individual industries. Thus, in the textile group, we find industries devoted to the manufacture of cotton goods, hosiery and knit goods, woolen and worsted goods, silk goods, carpets and rugs, fur-felt hats, and cordage and twine. An attempt is made to secure indices for all the more important individual industries. The group indices are built up from these.

Still further down the scale, below the indices for individual industries, stand the relatives for particular lines in such industries. Thus, for census years, the industry of "slaughtering and meat packing," under the group of "food and kindred products," is represented by four series showing the dressed weight of beeves, calves, sheep, and hogs used in the industry. The index for the "slaughtering and meat packing" industry in 1899, 1904, 1909, and 1914, rests upon these four lesser series. The annual index for this same industry is based upon three series showing separately the receipts of cattle, hogs, and sheep at seven of the largest live-stock markets. In a considerable proportion of cases, the indices for individual industries rest upon single commodity series assumed to reflect the course of the industry as a whole. In many cases, however, the indices for individual industries combine, as described, the relatives of particular materials important in the industry.

The manufacturing index thus is built up step by step from smaller elements. Single industry indices are secured from single commodity, or combinations of single commodity, relatives. Indices for important groups of industries are obtained by combining single industry indices. Finally, the index for manufacture as a whole is developed by consolidating the several group indices.

The construction of the manufacturing index follows the general method previously employed in developing the indices for agriculture and mining. In this installment only the unadjusted index is developed. From the census data, this index is derived for the years 1899, 1904, 1909, and 1914; from the annual data, for the entire period from 1899 to 1919. In constructing the unadjusted index, the original items are first reduced to relatives of the items of a base period — the year 1909 in the case of manufacturing — and weighted geometric means then taken of the relatives of each year. Weights of series for each industry covered are made proportionate to the aggregate value of products or of materials used (as the case may be) for the base year, 1909. Weights of industries are made proportionate to the aggregate "value added by manufacture" for all industries covered for the base year; weights of groups are made proportionate to the aggregate value added by manufactures for all groups covered for the base year. The year 1909 is taken as a base period in the manufacturing index for the reasons that (1) it is covered by the reports of the Twelfth Decennial Census and hence offers unusual opportunities for the accurate determination of the relative importance of the different lines of manufactures; (2) it is the most recent census year for which data are at the same time fully available and entirely unaffected by the war; and (3) it is a year in which the volume of production was fairly normal. After the annual manufacturing index has been constructed with 1909 as a base and then "corrected" to bring it into agreement with the index based on the census years, the base is shifted to the geometric average of 1909–13. This makes directly comparable the indices of agriculture, mining, and manufacture, and brings more clearly into view the essential differences in the courses of physical production in these three major divisions of industrial activity.

The index for manufacture based upon annual data for the full period from 1899 to 1919, rests upon the index based upon census data for the years 1899, 1904, 1909, and 1914. The analysis of census data is consequently undertaken first. The corresponding analysis of annual data will follow.

A. THE INDEX FOR CENSUS YEARS 1899, 1904, 1909, AND 1914

MATERIAL UTILIZED AND SOURCES

(a) *General*

The series utilized in the construction of our index of physical production for manufacture in 1899, 1904, 1909, and 1914, consist in the main of data compiled by the Bureau of the Census and published in the *Abstract of the Census of Manufactures* for 1914. They relate to calendar years, or, in the case of some individual firms, to the "twelve-month periods ending within" the calendar years. The figures which we have selected cover returns only for establishments whose chief business was the industry named. By restricting the data to such establishments it is possible to secure comparability between industries. To secure data comparable from year to year, the census has retained "as far as possible the same form of schedule" throughout, and has also revised its figures for 1899 by excluding neighborhood, household, and hand industries. These industries have not been canvassed since 1904, in which year the inquiry was first limited to establishments operated under the factory system. In view of the precautions taken by the Bureau of the Census, the series relating to manufacture from census to census may be considered fairly homogeneous.

From the various series published in the *Abstract of Manufactures* two sets were taken: (1) quantities of materials used and (2) quantities of products, having respectively a cost or value of not less than $10,000,000 in 1914. The few industries measuring up to this standard under the miscellaneous group, however — ice, musical instruments, etc. — were omitted as too small and heterogeneous a sample.[1] The products transcribed relate to articles manufactured during the year, not to articles sold; and materials refer to amounts used, not to amounts purchased. The nomenclature and classification of the census has been followed in this study.

Where figures on quantity were not reported by the census, but were available elsewhere, the other sources were used. Thus, for metals other than iron and steel, data were taken from Geological Survey and Mint reports, for liquors and tobacco, from the *Annual Report of the Commissioner of Internal Revenue*, and for cane sugar, from the *Statistical Abstract*, as explained below under (b) *Individual Series*.

Costs or values in the year 1909 were selected as the bases for weights in combining the series, industries, and groups. The data were taken from the *Abstract of Manufactures*. For materials, costs represent cost at the factory, and include freight charges; for products, values represent net selling price, excluding freight charges and commercial discounts, but including the price of containers in which the goods are sold, and manufacturers' profits. While these money equivalents served as weights for combining materials or products within an industry, "the value added by manufacture" was chosen as more appropriate for weighting industries and groups of industries. This "value added" the census derives by deducting "total cost of materials, including fuel and mill supplies, from the value of products."

(b) *Individual Series*

In this section, those individual series and industries are discussed which are known to be peculiar in respect to source, method of compilation, etc. The actual data for all series and industries, including quantities, costs of materials, values of products, and value added by manufacture, are given in Table A (see pp. 316–320).

GROUP I

Butter, Cheese, and Condensed Milk: Butter and *Cheese*. The usual practice of the census for this industry, as for others, has been to report only those products made in factories. In 1899 and 1914, however, it collected also "statistics as to the production of butter and cheese in urban dairies," and apparently included the returns in its general totals except "where the manufacture of butter or cheese . . . was incidental to the purchase and sale of milk and cream."

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[1] A minor omission may also be noted. The main product of the salt industry had a value just over $10,000,000 in 1914, but so much less in other years that salt was left out. Other products and industries, viz., oleo oil, cotton waste, hominy and grits, rice cleaning, and tin and terne plates, though transcribed, were dropped out in the process of weighting as insignificant relative to other products or industries grouped with them.

Slaughtering and Meat packing: Sheep and lambs and goats and kids, dressed weight. For 1899 and 1904, goats and kids were not included because of lack of data. That their omission did not greatly affect the total, however, is indicated by the fact that in 1909, goats and kids slaughtered for food in slaughter-houses numbered only 166,000 as compared with over 14,000,000 sheep and lambs.[1] *Meat, fresh and cured.* The series presented under this title was computed by adding the following items reported separately by the census: beef, veal, mutton and lamb, pork, edible offal and all other fresh meat, pickled and other cured beef, pickled and other cured pork. Of these, the most important both in quantity and value were fresh beef, cured pork, and fresh pork. *Lard and lard compounds.* Only in 1914 did the census separate the output of lard compounds and substitutes from that of lard. To make 1914 comparable with earlier years, therefore, it was necessary to add the two amounts given. *Hides and skins, cattle and calf.* The 1899 figure for this series includes an unknown quantity of sheep, lamb, goat, and kid skins, which were grouped in a single separate class at later censuses. Since weight in pounds is not stated for this class, it cannot be combined with the series taken, which was computed by adding together the output in pounds of calf and of cattle skins. Hides and skins reported for sheep, lamb, goats, and kids exceed those of cattle and calf in number, but are only one-fifth to one-sixth as valuable in 1904, 1909, and 1914.

Flour-mill and Gristmill Products: Grain ground or milled includes wheat, corn, rye, buckwheat, barley, oats, and other grains. Separate quantities might have been taken for the more important of these, except that the *Abstract* does not give the separate costs necessary for weighting. *Wheat flour* consists of white flour plus an almost negligible quantity of graham and whole wheat flour. *Feed and offal and bran and middlings.* To get a figure for 1914 uniform with data for earlier years, the total for bran and middlings was added to that for feed and offal, which had not previously been stated separately.

Beet Sugar: In 1899, 29 per cent of the *beet sugar* reported was raw, the rest granulated. In 1904, only 2 per cent and since then less than 1 per cent raw sugar entered the totals, which for these years pertain almost wholly to refined sugar.

Cane Sugar Refining: The weight for this industry, value added by manufacture in 1909, was secured by summing the value added by industries crushing domestic cane and by industries refining raw sugar, as reported by the census. *Cane sugar* is one of the few series not taken from the *Abstract of Manufactures*, which contains the desired figures for 1914 only. Instead, quantities were computed from the *Statistical Abstract* of 1919 by adding imports from non-contiguous United States and from foreign countries in the fiscal years 1899, 1904, 1909 and 1914 to production of continental United States for the crop years preceding. Presumably the total supply thus obtained, being largely imported raw sugar, served for the most part as material for our sugar refineries.

Canning and Preserving Fruits and Vegetables: This industry differs from others in that data include "fruits and vegetables canned and preserved by establishments engaged primarily in other industries." The value of products in 1914, $158,000,000, includes $9,000,000 due to such other establishments. *Canned vegetables.* The total number of cases given was computed by adding the number for tomatoes, beans, peas, corn, and other vegetables. Regarding the unit employed, the census states that "the case, which is used as the unit of measure for canned goods, consists of 24 standard-size cans — no. 2 for beans, corn, peas, berries, cherries, and plums, and no. 3 for all other fruits and vegetables. . . . Where the output was reported by the canneries in cans of other sizes than no. 2 and no. 3 the quantities so reported have been reduced to equivalent standard cases."[2] *Canned fruits.* Here again the total was computed by adding the number of cases reported under each variety. The definition of the case given under canned vegetables applies equally to canned fruits.

Group II

Cotton Manufactures: Woven goods. Besides giving the total figures transcribed for this series, the census distinguishes several kinds of woven goods entering the total. The most valuable of these classes in 1914 were sheetings and shirtings, fancy weaves, ducks, ginghams, and napped fabrics.

Hosiery and Knit goods: Products in this industry are reported "irrespective of the materials used," whether silk, cotton, wool, or other fiber. *Cotton.* In 1914, the census reported four classes of cotton: domestic, foreign, carded and other prepared, and waste purchased. These classes, having been distinguished only in part or not at all at previous enumerations, were combined in each year in which they appeared into a single total. *Cotton yarn* comprises two varieties: cotton and mercerized cotton. The latter was not reported separately before 1914. The series for *hoods, sweaters,* etc., has been compiled by adding separate products reported in the *Abstract*, viz.: (1) hoods, scarfs, etc., (2) cardigan jackets, sweaters, etc., and (3) shawls. By far the most important of these are the cardigan jackets, etc., which in 1909 had alone a value of $22,000,000 out of the $27,000,000 total.

Silk Goods, Including Throwsters: Yarns other than silk. The kinds of yarn combined under this series are: cotton, including mercerized, woolen or worsted, mohair, and all other. None of these alone cost $10,000,000; the largest single item was cotton yarn, which in 1914 cost $7,000,000. *Broad silks* include both all-silk goods and mixed goods. *Velvets, plushes, upholstery and tapestries*, though not reported in total by the census, were added to form this series. *Other silk goods* have also been compiled by adding separate classes given in the *Abstract*, as follows: machine twist, sewing and embroidery silks, fringe and floss silks, organzine for sale, tram for sale, and spun silk for sale.

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[1] *Abstract of the Census of Manufactures*, 1914, pp. 37, 38.

[2] *Ibid.*, p. 43.

Woolen and Worsted Goods. Wool used comprises domestic and foreign wool in condition purchased. *All-wool woven goods*, *Union or cotton mixed, woven goods*, and *Cotton-warp woven goods.* For each of these three series the census reports numerous subclasses, among which coatings, overcoatings, and dress goods are of outstanding importance. *Yarns and tops.* The yarns added to form this series are woolen, worsted, union or merino woolen, union or merino worsted, and "other." With these were combined, for the last three censuses, worsted tops and slubbing, which the census in 1899 included with worsted yarns.

Carpets and Rugs, Other Than Rag: Yarns include yarns of wool, worsted, cotton, linen, and jute, ramie, and other vegetable fiber, none of these materials taken alone costing $10,000,000.

Cordage and Twine and Jute and Linen Goods: The value added by manufacture for this industry is not reported in total, but was obtained by adding separate figures for (1) cordage and twine, (2) jute, and (3) linen goods. *Hard fibers*, *Soft fibers*, *Rope and binder twine, exclusive of cotton rope*, and *Twine, other than binder* were not reported by the census in 1904. To approximate the quantities for this year, an interpolation was made in each series on the assumption that the increase from 1899 to 1904 was proportionate to the increase from 1904 to 1909; i.e., the interpolations are geometric means of census figures for 1899 and 1909. *Twine, other than binder*, as reported by the census, comprises cotton, jute, hemp, flax, and other, including mixed, twines.

GROUP III

Blast Furnaces: Iron ore consumed is chiefly domestic, but includes foreign ore equal in 1914 to about 4 per cent of the total. *Pig iron, including ferroalloys.* The figures for pig iron include direct castings, together with the ferroalloys, spiegeleisen, ferromanganese, ferrosilicon, and "other." The larger part of the pig-iron output is consumed in the works of the producing companies. In 1904, for example, only two-fifths of the production was sold, and in 1914, barely one-third.

Steel Works and Rolling Mills: Scrap[1] includes old rails not intended for rerolling. A better series than that given would be total consumption, secured by adding the amount received from outside sources to the amount made and consumed in the same works, but data on this second point are available only for the last two censuses. In 1914, the quantity made and consumed in the same works was 10 per cent greater than supplies from outside sources. *Rolled, forged, and other classified iron and steel products.* Under this title the census groups a variety of finished rolled products and of partly finished rolled products and unrolled steel for sale or for transfer to other works of the same company. This grouping doubtless leads to some duplication of quantities, since the relatively crude products sold or transferred by one establishment are reported by another, after further manufacture, as finished products. Another cause of duplication is the practice of giving the *total* output of products such as plates and sheets, even though a large part may be worked into more finished form in the producing mill, and reported under this new form. There is no means, however, of eliminating the amounts duplicated in these two ways. Besides the plates and sheets already mentioned, the finished products having the largest value in 1909 were rails, structural shapes, merchant bars, wire rods, and skelp.

GROUP IV

Lumber and Timber Products: The value added by manufacture for this industry is inclusive of some production of pulpwood, very defectively reported. *Softwoods* and *Hardwoods.* Separate values were not published by the census for these products, which were weighted equally in calculating the index for the industry.

GROUP V

Leather, Tanned, Curried, and Finished: Sole leather. In addition to giving in total the number of sides finished for sole leather, the *Abstract* classifies the production according to the chemical process employed.

GROUP VI

Paper and Wood Pulp: Pulpwood. "The quantity of pulpwood reported in 1909 represents that used by all mills manufacturing wood pulp, which includes a few where it was not the primary product."[2] So many products were reported by the census for this industry that it seemed advisable for ease in handling to combine similar classes, as in the several cases noted below. *Book paper.* Here four kinds of book paper were totaled: plain, coated, cover, and plate, etc. *Fine paper* comprises the two classes: writing, and all other fine. *Wrapping paper.* The varieties of wrapping paper added to form this series are: manila, heavy, straw, bogus or wood manila, kraft, and all other. *Boards.* In this total are included wood pulpboard, strawboard, news board, binders' boards, leather boards, and all other. *Miscellaneous papers.* This series, as its name implies, covers a varied assortment of products, as follows: cardboard, tag stock, hanging, poster, tissue, blotting, building, etc., and all other paper. It is to some extent misleading to lump in this way products of unequal value, such as tissue paper and building paper, whose output may increase or decrease at quite different rates. But since all the values involved are small, no one equaling $10,000,000 in 1909, any error arising may be considered negligible.

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[1] From outside sources.

[2] *Abstract of the Census of Manufactures*, 1914, p. 156, footnote 1.

GROUP VII

Liquors, Distilled and *Liquors, Malt:* A peculiarity of these two industries is that the value added by manufacture includes "a very large amount of tax paid to the Federal Government," and is therefore "misleading as an indication of their relative importance from a purely manufacturing standpoint." [1] To secure truer weights for the industries, the 1909 taxes of $151,000,000 on distilled and $62,000,000 on malt liquors were deducted from the values added by manufacture. *Distilled spirits* and *Fermented liquors.* Although values added by manufacture for the industries of which these are products pertain to calendar years, output of the products themselves relates to fiscal years ending June 30. Physical production is not given by the census, but was secured from the *Annual Report of the Commissioner of Internal Revenue.* Distilled spirits cover those distilled from molasses and fruit as well as from grains.

GROUP VIII

Coke, Not Including Gas-House Coke: All the data for this industry have been transcribed from the *Abstract of Manufactures*, though for 1914 the *Abstract* took its figures from the Geological Survey, in order to save duplication of work. The Survey publishes annual data, which agree substantially with the census returns except for 1904. In that year the census, which is the source retained, reports about 2½ per cent more coal used and about 6 per cent more coke produced than does the Survey. These discrepancies the census attributes to the different methods employed by the two bureaus.[2] It should also be noted that in 1904, 1909, and 1914, but not in 1899, the census figures include returns made by establishments engaged primarily in other industries. *Oil, benzol and benzine.* In 1909 and 1914, three classes of materials which had formerly been reported as one were distinguished; viz., oil used for gas making, benzene or benzol, and benzine, gasoline or naphtha. To make the figures comparable for all the censuses, these three classes were totaled. *Coke.* This series comprises both beehive and by-product coke. In 1904, about one-tenth, and in 1914, about one-third of the total output was from by-product ovens; the rest was from beehive ovens.

Fertilizers reported by the census consist almost entirely of "complete and ammoniated fertilizers" and "superphosphates."

Paint and Varnish: The census, in reporting materials and products, combines statistics for the two industries, *Paints* and *Varnishes.* Value added by manufacture, however, is given for each, and the total constitutes the weight for the industry. *Pig lead* and *Linseed oil.* Data not being available for 1909, the quantity of linseed oil used in that year was interpolated on the basis of pig lead. About the same amount of pig lead was used in 1909 as in 1914; therefore it was assumed that linseed oil used in 1909 approximated that used in 1914. The two materials were weighted equally, after comparison of their cost in 1914. *White lead pigment.* Some duplication probably occurs in the quantities of products reported for this industry, since three-fifths to four-fifths of white lead pigment produced is consumed in the manufacture of other products. The 1909 value used for weighting white lead pigment was computed by multiplying the total output by the price per pound of the amount sold.

Chemicals and Acids: Unlike the general practice in reporting, the output of goods in this instance embraces returns from all producing firms, even though they are engaged chiefly in other business. Also, though the manufacture of sulphuric, nitric, and mixed acids is largely distinct from that of chemicals, the census combines the two industries in presenting quantities of materials and products. For weighting, therefore, a similar combination of values added by manufacture was made. *Sulphuric acid.* This product, particularly in 1909, is made to appear smaller than it should be by the fact that some establishments reported all acids in lump, so that detail for the different kinds could not be given. *Glycerine.* Before 1914, only crude glycerine for sale was reported, but in that year refined glycerine was also given. Since much of the crude material used in this refined product was not stated separately, however, the two classes were added to form the 1914 total.

Oil, Cottonseed, and Cake: Crude oil, Cake and meal, Hulls, and *Linters.* The values of these four products was not stated in the *Abstract*, and they were weighted equally.

Petroleum Refining. Naphthas and lighter products. Of the 29,000,000 barrel output reported for this series in 1914, 24,000,000 barrels consisted of gasoline from petroleum refineries. Prior to 1914, gasoline was not distinguished from the other products.

GROUP IX

Brick and Tile, Terra-cotta, and Fire-clay Products: For 1909 the census did not report for this industry value added by manufacture, but for 1914 it reported a value added of $93,000,000. The only other industry in Group IX, *Glass*, had in 1914 an added value of $77,000,000, which gave a ratio of 1.21 between the two. Applying the rule of three yielded $73,000,000 as the 1909 figure for *Brick and Tile*, etc. *Common brick* and *Fire brick.* The 1914 data for these two series are not entirely homogeneous with earlier years. Compiled by the United States Geological Survey, the quantities represent amounts sold in 1914, while in other years the census reported "production, some of which may not have been sold." It seems improbable that these different methods affected the figures greatly, however, and the series have been retained as the best available.

Glass: Bottle and jars. To obtain the totals for this series there were added quantities produced of nine different classes of bottles and jars, as follows: (1) prescriptions, vials, and druggists' wares; (2) beer, soda, and mineral; (3) liquors and flasks; (4) milk jars; (5) fruit jars; (6) battery jars and other electrical goods; (7) patent and proprietary; (8) packers and preservers; (9) demijohns and carboys. All units were converted to the gross of twelve dozen. *Pressed and blown glass.* As with the preceding series, many separate items were combined to form the total dozens of pieces of pressed blown glass. The list follows: (1) tableware; (2) jellies, tumblers, and goblets; (3) lamps; (4) chimneys; (5) lantern globes; (6) shades, globes and other gas goods; (7) blown tumblers, stem ware, and bar goods; (8) opal ware; (9) cut ware; (10) decorated glassware.

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[1] *Abstract of the Census of Manufactures*, 1914, p. 28.

[2] *Thirteenth Census of the United States*, 1910, x, p. 632.

GROUP X

Practically nothing in this group but the title and the group weight has come from the *Abstract of Manufactures*, which report does not contain quantities of materials or products for industries manufacturing "metals and metal products other than iron and steel." To get an indication of the condition of these industries, the consumption of industrial metals reported by the Geological Survey and the Bureau of the Mint was used. In forming the single index for the group, each metal was weighted according to the aggregate value of the amount consumed in 1909, which was secured by multiplying the quantity by the average price for the year.

Copper: The annual report on *Mineral Resources of the United States* published by the Geological Survey contains estimates on copper consumption as far back as 1884. Estimates prior to 1900, however, take no account of stocks on hand at the first and last of the year, and cannot be compared with those beginning with 1900, which make allowance for stocks. Therefore, the figure for 1900 has been quoted in place of that for the census year 1899. But though estimates for the last twenty years may be supposed to be roughly comparable, the Geological Survey states that they are not fully so. Before 1906, "errors of greater or less magnitude" entered, because figures were not calculated from refined copper, "the true basis of consumption," but from "smelter production and imports and exports of materials, only part of which were in the refined state."[1] In 1906 the method now in use was adopted of deducting from refinery output plus stocks on January 1 exports of refined copper and refinery stocks as of December 31. Imports are not added to the first part on the ground that refined copper imported is "re-refined, and is included in total refinery output."[2] This change in the way of compiling the figures makes the results for 1900 (which we use for 1899) and 1904 more comparable with each other than with the later estimates for refined new copper, and *vice versa*.

Zinc: From the annual series published by the Geological Survey in *Mineral Resources*, figures for the four census years have been taken. They relate only to the consumption of new zinc, and are computed by adding production, imports, and stocks on January 1, and subtracting exports and stocks on December 31.

Lead: The census year data on lead consumption published by the Geological Survey appear quite comparable, more so than the annual data. The explanation is that while the annual figures sometimes include and sometimes omit domestic smelter stocks, these stocks happened to be omitted in each census year. In the series quoted the only discrepancy is that the figures for 1899 and 1904 apparently exclude lead in ore and base bullion, while figures for 1909 and 1914 cover all kinds of lead except that recovered from scrap. Otherwise the four estimates are calculated by the same formula: domestic production and net imports plus or minus the decrease or increase of stocks in bonded warehouses.

Gold and *Silver:* The Bureau of the Mint, on the basis of information from its branch and assay offices, publishes in its annual report the best available estimates of the industrial consumption of gold and silver. As an indication of the activity of industries using these metals, the total amounts reported by the Mint were taken; i.e., not only the quantity of coin and new bullion consumed, but also the quantity of metal recovered by melting down old plate and jewelry.

GROUP XI

It would have been desirable, in weighting the industries in this group, to deduct internal revenue taxes from values added by manufacture, but this was not done because the census did not state the taxes separately for each industry. Data on physical production were transcribed from the *Annual Report of the Commissioner of Internal Revenue.* The Commissioner states that the figures were "compiled from an annual abstract statement of manufacturers' accounts prepared by collectors of internal revenue at the close of each calendar year," and "relate exclusively to products manufactured in the United States."

Tobacco, Chewing and Smoking, and Snuff: Tobacco and snuff. The kinds of tobacco included in this series are plug, twist, fine cut, and smoking. *Tobacco, cigars, and Tobacco, cigarettes.* In the Commissioner's *Annual Report* both cigars and cigarettes are classified as "weighing more than 3 pounds per 1000" and "weighing not more than 3 pounds per 1000." The predominant class of each product was taken; i.e., cigars "weighing more than 3 pounds per 1000," and cigarettes "weighing not more than 3 pounds per 1000."

GROUP XII

Automobiles: Automobiles manufactured include gasoline, steam, and electric, all of which the *Abstract of Manufactures* reports, beginning, however, only with 1904. The number of "motor vehicles" (including both passenger cars and auto trucks) manufactured in 1899 was reported by the *Twelfth Census* (Vol. X, p. 255) as 4,192. To err on the right side, we have taken the round number of 5,000 cars as the output for 1899.

Carriages, Wagons, and Repairs: Complete vehicles of

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[1] U. S. Geological Survey, *Mineral Resources of the United States*, 1906, 421; 1907, i, 637.

[2] U. S. G. S., op. cit., 1907, i, 638.

TABLE A, PART I. — DATA (INCLUDING ACTUAL ITEMS, WEIGHTS, AND RELATIVES) USED IN THE COMPUTATION OF INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE, *based on Materials supplemented by Products*, FOR THE CENSUS YEARS 1899, 1904, 1909, 1914

	ACTUAL ITEMS OF AVAILABLE SERIES					WEIGHTS USED AND THEIR BASES				RELATIVES AND WEIGHTED GEOMETRIC MEANS			
	Units	1899	1904	1909	1914	Cost of materials or value of products in 1909	Weights of series	Value added by manufacture in 1909	Weights of industries and groups	1899	1904	1909	1914
						million dollars		*million dollars*					
ALL GROUPS OF INDUSTRIES COVERED	....	....	....	....	....	....	...	**7,359**	...	**61.2**	**75.4**	**100.0**	**104.9**
Group I. — Food and Kindred Products	....	....	....	....	....	....	...	**750**	**10**	**69.3**	**86.6**	**100.0**	**105.8**
Materials													
Butter, cheese, and condensed milk	....	....	....	....	....	....	...	*39*	*10*	*41.4*	*71.7*	*100.0*	*120.2*
Milk	Mill. lbs.	11,678	12,147	9,889	8,431	119	1	....	...	118.1	122.9	100.0	85.3
Cream	Mill. lbs.	204	588	1,406	2,384	95	1	....	...	14.5	41.8	100.0	169.5
Slaughtering and meat packing	....	....	....	....	....	....	...	*164*	*40*	*81.2*	*92.7*	*100.0*	*95.5*
Beeves, dressed weight	Mill. lbs.	3,223	4,066	4,410	3,786	392	10	....	...	73.1	92.2	100.0	85.9
Calves, dressed weight	Mill. lbs.	80	161	262	206	25	1	....	...	30.3	61.4	100.0	78.6
Sheep and lambs, and goats and kids, dressed weight	Mill. lbs.	389	465	497	630	60	1	....	...	78.4	93.6	100.0	126.8
Hogs, dressed weight	Mill. lbs.	5,203	5,049	5,202	5,476	483	10	....	...	100.0	97.1	100.0	105.2
Flour-mill and gristmill products	....	....	....	....	....	....	...	*116*	*30*	*90.4*	*93.6*	*100.0*	*101.5*
Grain, ground or milled	Mill. bushels	729	755	806	819	....	...	....	...	90.4	93.6	100.0	101.5
Beet sugar	....	....	....	....	....	....	...	*21*	*5*	*20.0*	*54.8*	*100.0*	*142.2*
Beets	Thous. sh. tons	795	2,175	3,965	5,639	....	...	....	...	20.0	54.8	100.0	142.2
Cane sugar refining	....	....	....	....	....	....	...	[a] *31*	*8*	*69.7*	*80.0*	*100.0*	*113.7*
Cane sugar[b]	Mill. lbs.	4,549	5,222	6,530	7,424	....	...	....	...	69.7	80.0	100.0	113.7
Products													
Canning and preserving fruits and vegetables	....	....	....	....	....	....	...	*29*	*7*	*45.1*	*82.9*	*100.0*	*141.8*
Canned vegetables	Mill. cases	19.33	29.72	33.80	50.26	53	5	....	...	57.2	87.9	100.0	148.7
Canned fruits	Thous. cases	4,468	4,628	5,529	9,449	13	1	....	...	80.7	83.6	100.0	170.9
Dried fruits	Mill. lbs.	84.7	325.4	454.9	521.4	22	2	....	...	18.6	71.5	100.0	114.6
Group II. — Textiles and their Products	....	....	....	....	....	....	...	**1,315**	**18**	**67.0**	**77.6**	**100.0**	**105.4**
Materials													
Cotton manufactures	....	....	....	....	....	....	...	*257*	*13*	*77.5*	*80.6*	*100.0*	*108.3*
Cotton, raw	Mill. lbs.	1,818	1,876	2,335	2,524	275	10	....	...	77.8	80.3	100.0	108.1
Cotton yarns	Mill. lbs.	94.7	105.4	126.7	139.5	34	1	....	...	74.8	83.2	100.0	110.1
Hosiery and knit goods	....	....	....	....	....	....	...	*90*	*5*	*60.7*	*74.7*	*100.0*	*106.9*
Cotton	Mill. lbs.	49.5	50.6	75.4	114.6	9	1	....	...	65.7	67.1	100.0	152.0
Cotton yarns	Mill. lbs.	131.8	161.5	217.0	205.6	48	5	....	...	60.7	74.4	100.0	94.7
Worsted yarns	Mill. lbs.	5.82	8.79	10.37	14.31	10	1	....	...	56.2	84.8	100.0	138.0
Silk goods, including throwsters	....	....	....	....	....	....	...	*89*	*5*	*56.8*	*69.7*	*100.0*	*127.1*
Raw silk	Thous. lbs.	9,761	11,573	17,472	22,375	68	10	....	...	55.9	66.2	100.0	128.0
Organzine and tram	Thous. lbs.	2,338	3,237	3,378	3,856	15	2	....	...	69.2	95.9	100.0	114.1
Yarns, other than silk	Mill. lbs.	7.12	9.73	15.79	23.26	8	1	....	...	45.1	61.6	100.0	147.3
Woolen and worsted goods	....	....	....	....	....	....	...	*146*	*7*	*57.2*	*73.3*	*100.0*	*94.0*
Wool, in condition purchased	Mill. lbs.	330.2	418.7	474.8	434.7	137	10	....	...	69.5	88.2	100.0	91.6
Tops	Mill. lbs.	5.56	9.16	20.83	29.11	15	1	....	...	26.7	44.0	100.0	139.7
Worsted yarns	Mill. lbs.	25.11	31.05	59.15	53.63	56	4	....	...	42.5	52.5	100.0	90.7
Carpets and rugs, other than rag	....	....	....	....	....	....	...	*32*	*2*	*84.1*	*93.3*	*100.0*	*91.0*
Wool, in condition purchased	Mill. lbs.	51.87	51.32	64.14	52.55	12	1	....	...	80.9	80.0	100.0	82.0
Yarns	Mill. lbs.	109.3	128.6	127.6	122.3	21	2	....	...	85.7	100.8	100.0	95.8
Cordage and twine, jute and linen goods	....	....	....	....	....	....	...	[a] *20*	*1*	*79.1*	*88.9*	*100.0*	*119.2*
Hard fibers	Mill. lbs.	275.9	[c] 311.9	352.7	437.3	20	2	....	...	78.2	88.4	100.0	124.0
Soft fibers	Mill. lbs.	248.8	[c] 276.4	307.0	338.3	11	1	....	...	81.0	90.0	100.0	110.2
Products													
Hats, fur felt	....	....	....	....	....	....	...	*26*	*1*	*63.0*	*87.4*	*100.0*	*70.9*
Hats, fur felt	Thous. doz.	1,882	2,612	2,989	2,119	....	...	....	...	63.0	87.4	100.0	70.9
Group III. — Iron and Steel and their Products	....	....	....	....	....	....	...	**1,365**	**19**	**58.2**	**70.1**	**100.0**	**93.9**
Materials													
Blast furnaces	....	....	....	....	....	....	...	*71*	*2*	*52.5*	*62.3*	*100.0*	*87.8*
Iron ore	Mill. long tons	25.37	30.03	48.35	43.33	187	15	....	...	52.5	62.1	100.0	89.6
Fluxes	Mill. long tons	7.32	8.33	13.57	11.50	12	1	....	...	53.9	61.4	100.0	84.8
Coke	Mill. short tons	16.46	19.74	31.44	26.88	102	10	....	...	52.3	62.8	100.0	85.5
Steel works and rolling mills	....	....	....	....	....	....	...	*328*	*8*	*59.7*	*72.1*	*100.0*	*95.5*
Pig iron, including ferroalloys	Thous. long ton	10,410	12,190	19,080	17,430	298	4	....	...	54.6	63.9	100.0	91.4
Scrap, from outside sources	Thous. long ton	4,127	5,124	4,804	5,071	73	1	....	...	85.9	106.7	100.0	105.5
Ingots, blooms, billets, etc.	Thous. long ton	3,876	4,920	6,508	6,458	146	2	....	...	59.5	75.6	100.0	99.2

For footnotes, see p. 318.

TABLE A, PART 1. — *Continued*

	ACTUAL ITEMS OF AVAILABLE SERIES					WEIGHTS USED AND THEIR BASES				RELATIVES AND WEIGHTED GEOMETRIC MEANS			
	Unit	1899	1904	1909	1914	Cost of materials or value of products in 1909	Weights of series	Value added by manufacture in 1909	Weights of industries and groups	1899	1904	1909	1914
						million dollars		*million dollars*					
Group IV. — Lumber and its Remanufactures	....	....	....	....	....	....	...	**870**	**12**	**79.2**	**71.8**	**100.0**	**80.6**
Products													
Lumber	....	....	....	....	....	....	...	*488*	*1*	*79.2*	*71.8*	*100.0*	*80.6*
Softwoods	Mill. M ft. board measure	26.15	27.35	33.90	29.41	*d*	1	....	...	77.1	80.6	100.0	86.8
Hardwoods	Mill. M ft. board measure	8.63	6.78	10.61	7.94	*d*	1	....	...	81.4	63.9	100.0	74.8
Group V. — Leather and its Finished Products	....	....	....	....	....	....	...	**323**	**4**	**78.4**	**91.6**	**100.0**	**99.3**
Materials													
Leather, tanned, curried, and finished	....	....	....	....	....	....	...	*80*	*8*	*81.2*	*91.7*	*100.0*	*93.8*
Cattle hides	Mill. hides	15.84	17.58	18.36	17.46	119	10	....	...	86.3	95.8	100.0	95.1
Calf and kip skins	Mill. skins	8.94	12.48	19.73	16.07	32	2	....	...	45.3	63.3	100.0	81.5
Goat and kid skins	Mill. skins	48.05	47.67	48.08	37.76	28	2	....	...	99.9	99.1	100.0	78.5
Sheep and lamb skins	Mill. skins	24.51	27.49	26.08	40.09	12	1	....	...	94.1	105.5	100.0	153.7
Products													
Boots and shoes, leather	....	....	....	....	....	....	...	*165*	*16*	*76.5*	*91.0*	*100.0*	*102.7*
Boots, shoes, and slippers	Mill. pairs	218.0	242.1	285.0	292.7	....	...	....	...	76.5	91.0	100.0	102.7
Gloves and mittens, leather	....	....	....	....	....	....	...	*10*	*1*	*86.0*	*100.0*	*100.0*	*91.5*
Gloves, mittens, and gauntlets	Thous. dz. pairs	2,896	3,370	3,369	3,082	....	...	....	...	86.0	100.0	100.0	91.5
Group VI. — Paper and Printing	....	....	....	....	....	....	...	**728**	**10**	**50.4**	**72.4**	**100.0**	**119.2**
Materials													
Paper and wood pulp	....	....	....	....	....	....	...	*102*	*1*	*50.4*	*72.4*	*100.0*	*119.2*
Pulp wood	Thous. cords	1,986	3,051	4,002	4,471	34	3	....	...	49.6	76.2	100.0	111.7
Wood pulp	Thous. sh. tons	644	878	1,242	1,522	44	4	....	...	51.8	70.7	100.0	122.5
Rags, including cotton and flax waste, and sweepings	Thous. sh. tons	234.5	294.6	357.5	361.7	11	1	....	...	65.6	82.4	100.0	101.2
Old or waste paper	Thous. sh. tons	356	589	984	1,510	14	1	....	...	36.2	59.8	100.0	153.5
Group VII. — Liquors and Beverages	....	....	....	....	....	....	...	**488**	**4**	**65.4**	**86.7**	**100.0**	**188.4**
Products													
Liquors distilled	....	....	....	....	....	....	...	*18*	*1*	*71.6*	*99.7*	*100.0*	*130.0*
Distilled spirits, total [e]	Mill. gallons	[f] 100.2	[f] 139.5	[f] 139.9	[f] 181.9	....	...	....	...	71.6	99.7	100.0	130.0
Liquors, malt	....	....	....	....	....	....	...	*216*	*11*	*64.9*	*85.6*	*100.0*	*117.4*
Fermented liquors [e]	Mill. bbls.	[f] 36.6	[f] 48.3	[f] 56.4	[f] 66.2	....	...	....	...	64.9	85.6	100.0	117.4
Group VIII. — Chemicals and Allied Products	....	....	....	....	....	....	...	**596**	**8**	**50.2**	**73.5**	**100.0**	**119.9**
Materials													
Coke, not including gas house coke	....	....	....	....	....	....	...	*32*	*2*	*50.8*	*63.0*	*100.0*	*87.0*
Coal	Mill. sh. tons	30.16	37.38	59.35	51.62	....	...	....	...	50.8	63.0	100.0	87.0
Fertilizers	....	....	....	....	....	....	...	*34*	*2*	*50.8*	*57.4*	*100.0*	*134.3*
Phosphate rock	Thous. sh. tons	788	889	1,549	2,081	....	...	....	...	50.8	57.4	100.0	134.3
Gas, illuminating and heating	....	....	....	....	....	....	...	*114*	*8*	*41.1*	*79.7*	*100.0*	*123.7*
Coal	Thous. sh. tons	2,487	4,432	4,941	6,117	16	1	....	...	50.3	89.7	100.0	123.8
Oil, benzol and benzine	Mill. gallons	194.9	411.0	579.7	716.8	17	1	....	...	33.6	70.9	100.0	123.6
Paint and varnish	....	....	....	....	....	....	...	[a] *46*	*3*	*66.0*	*85.3*	*100.0*	*100.2*
Pig lead	Thous. sh. tons	99.1	129.6	150.2	150.8	[h] 11	1	....	...	66.0	86.3	100.0	100.4
Linseed oil	Mill. gallons	16.16	20.64	[c] 24.48	24.48	[h] 12	1	....	...	66.0	84.3	100.0	100.0
Petroleum refining	....	....	....	....	....	....	...	*38*	*2*	*43.0*	*55.5*	*100.0*	*158.4*
Crude petroleum	Mill. bbls.	52.0	67.0	120.8	191.3	....	...	....	...	43.0	55.5	100.0	158.4
Products													
Chemicals and acids	....	....	....	....	....	....	...	[a] *58*	*4*	*50.1*	*68.2*	*100.0*	*131.8*
Sulphuric acid	Thous. sh. tons	1,548	1,869	2,764	4,048	19	2	....	...	56.0	67.6	100.0	146.4
Soda ash	Thous. sh. tons	391	519	646	935	10	1	....	...	60.5	80.4	100.0	144.7
Glycerine	Mill. lbs.	26.51	46.97	79.68	77.51	12	1	....	...	33.2	58.9	100.0	97.3
Explosives	....	....	....	....	....	....	...	*17*	*1*	*44.3*	*74.0*	*100.0*	*98.8*
Explosives, total	Mill. lbs.	216.0	361.0	487.5	481.8	....	...	....	...	44.3	74.0	100.0	98.8
Oil, cottonseed, and cake	....	....	....	....	....	....	...	*28*	*2*	*55.7*	*81.1*	*100.0*	*135.2*
Crude oil	Mill. gallons	93.3	132.1	157.1	191.2	*d*	1	....	...	59.3	84.1	100.0	121.7
Cake and meal	Thous. sh. tons	884	1,344	1,662	2,192	*d*	1	....	...	53.2	80.8	100.0	131.9

For footnotes, see p. 318.

TABLE A, PART 1. — *Continued*

	ACTUAL ITEMS OF AVAILABLE SERIES					WEIGHTS USED AND THEIR BASES				RELATIVES AND WEIGHTED GEOMETRIC MEANS			
	Unit	1899	1904	1909	1914	Cost of materials or value of products in 1909	Weights of series	Value added by manufacture in 1909	Weights of industries and groups	1899	1904	1909	1914
						million dollars		*million dollars*					
Hulls	Thous. sh. tons	1,169	1,201	1,259	1,386	*d*	*1*	....	...	92.9	95.4	100.0	110.1
Linters	Mill. lbs.	57.3	116.7	174.6	330.6	*d*	1	....	...	32.8	66.8	100.0	189.3
Turpentine and rosin	....	....	....	....	....	....	...	*20*	*1*	*131.7*	*106.7*	*100.0*	*90.7*
Turpentine	Mill. gallons	37.73	30.69	28.99	26.98	13	1	....	...	130.2	105.8	100.0	93.1
Rosin	Thous. bbls.[j]	4,348	3,508	3,264	2,885	13	1	....	...	133.2	107.5	100.0	88.4
Group IX. — Stone, Clay, and Glass Products	....	....	....	....	....	....	...	**348**	**5**	**71.1**	**84.2**	**100.0**	**103.8**
Products													
Brick and tile, terra cotta and fire clay products	....	....	....	....	....	....	...	[a] *73*	*1*	*81.4*	*87.1*	*100.0*	*77.3*
Common brick	Mill. bricks	7,655	8,684	9,788	7,146	57	4	....	...	78.2	88.7	100.0	73.0
Fire brick	Mill. bricks	800.9	678.4	838.2	816.8	17	1	....	...	95.5	81.0	100.0	97.4
Glass	....	....	....	....	....	....	...	*60*	*1*	*62.1*	*81.5*	*100.0*	*139.3*
Window glass	Mill. sq. ft.	217.1	242.6	346.1	401.0	12	1	....	...	62.7	70.1	100.0	115.8
Plate glass, polished	Mill. sq. ft.	16.88	27.29	47.37	60.38	12	1	....	...	35.6	57.6	100.0	127.4
Bottles and jars[a]	Mill. dz. pieces	7.78	11.95	12.32	19.29	36	3	....	...	63.1	97.0	100.0	156.6
Pressed and blown glass[a]	Mill. gross	35.44	35.67	44.36	59.40	27	2	....	...	79.9	80.4	100.0	133.9
Group X. — Metals and Metal Products other than Iron and Steel	....	....	....	....	....	....	...	**348**	**5**	**51.9**	**73.4**	**100.0**	**104.0**
Copper, apparent consumption of refined new	Mill. lbs.	356.9	482.2	688.6	620.4	89	44	....	...	51.8	70.0	100.0	90.1
Zinc, consumption of primary	Thous. sh. tons	124.6	180.9	270.7	299.1	29	14	....	...	46.0	66.8	100.0	110.5
Lead, available for consumption	Thous. sh. tons	226.3	319.5	368.7	448.9	32	16	....	...	61.4	86.7	100.0	121.8
Silver, industrial consumption	Mill. fine oz.	12.13	20.48	27.90	29.31	15	7	....	...	43.5	73.4	100.0	105.1
Gold, industrial consumption	Thous. fine oz.	960	1387	1821	2202	38	19	....	...	52.7	76.2	100.0	120.9
Group XI. — Tobacco Manufactures	....	....	....	....	....	....	...	**240**	**3**	**69.6**	**86.9**	**100.0**	**114.7**
Products													
Tobacco, chewing and smoking, and snuff	....	....	....	....	....	....	...	*82*	*35*	*68.3*	*82.0*	*100.0*	*102.2*
Tobacco and snuff[e]	Mill. lbs.	294.6	353.7	431.4	440.9	....	...	....	...	68.3	82.0	100.0	102.2
Tobacco, cigars	....	....	....	....	....	....	...	*129*	*55*	*73.6*	*99.6*	*100.0*	*107.6*
Cigars, weighing more than 3 lbs. per 1000[e]	Million[l]	4,910	6,640	6,668	7,174	....	...	....	...	73.6	99.6	100.0	107.6
Tobacco, cigarettes	....	....	....	....	....	....	...	*25*	*10*	*54.9*	*50.2*	*100.0*	*247.2*
Cigarettes, weighing not more than 3 lbs. per 1000[e]	Million[m]	3,742	3,426	6,819	16,856	....	...	....	...	54.9	50.2	100.0	247.2
Group XII. — Vehicles for Land Transportation	....	....	....	....	....	....	...	**255**	**4**	**28.2**	**52.6**	**100.0**	**185.5**
Products													
Automobiles	....	....	....	....	....	....	...	*86*	*5*	*3.9*	*17.1*	*100.0*	*449.3*
Automobiles	Thous. cars	[n] 5.0	21.7	126.6	568.8	....	...	....	...	3.9	17.1	100.0	449.3
Carriages, wagons, and repairs	....	....	....	....	....	....	...	*61*	*4*	*104.8*	*112.7*	*100.0*	*74.1*
Complete vehicles of all classes	Thous. vehicles	1,594	1,712	1,520	1,126	....	...	....	...	104.8	112.7	100.0	74.1
Steam railroad cars	....	....	....	....	....	....	...	*45*	*3*	*132.3*	*123.6*	*100.0*	*144.5*
Passenger service	1 car	1,369	2,446	1,819	3,568	15	1	....	...	75.3	134.5	100.0	196.2
Freight service	Thous. cars	143.1	117.5	96.7	131.4	80	5	....	...	148.0	121.5	100.0	135.9
Group XIII. — Railroad Repair Shops[k]													
Group XIV. — Miscellaneous Industries[k]													

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a. Computed as explained under "Individual Series."

b. Compiled from the *Statistical Abstract*. See "Individual Series."

c. Interpolated, as explained under "Individual Series."

d. Not reported by the Census of Manufactures.

e. Transcribed from the *Annual Report of the Commission of Internal Revenue*. *f.* Fiscal years.

g. Bbls. of not more than 31 gallons.

h. Cost of materials in 1914.

i. Bbls. of 42 gallons.

j. Bbls. of 280 lbs.

k. No series of materials or products for Groups X and XIII available from the Census of Manufactures. The few industries in Group XIV for which products could be secured were omitted as unrepresentative.

l. Weighing more than 3 lbs. per 1000.

m. Weighing not more than 3 lbs. per 1000.

n. Reported as 4,192 cars in the Census of 1899.

TABLE A, PART 2. — DATA (ADDITIONAL TO THOSE PRESENTED IN PART 1, CONCERNING PRODUCTS) USED IN THE COMPUTATION OF INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE, *Based on Products*, FOR THE CENSUS YEARS 1899, 1904, 1909, 1914,

	ACTUAL ITEMS OF AVAILABLE SERIES					WEIGHTS USED AND THEIR BASES				RELATIVES AND WEIGHTED GEOMETRIC MEANS			
	Units	1899	1904	1909	1914	Value of products in 1909	Weights of series	Value added by manufacture in 1909	Weights of industries and groups	1899	1904	1909	1914
						million dollars		*million dollars*					
ALL GROUPS OF INDUSTRIES COVERED	....	....	....	....	....	....	...	**7,359**	...	**61.2**	**75.4**	**100.0**	**106.2**
Group I. — Food and Kindred Products	....	....	....	....	....	....	...	**750**	**10**	**72.0**	**87.4**	**100.0**	**110.3**
Butter, cheese, and condensed milk	....	....	....	....	....	....	...	*39*	*10*	*64.6*	*83.5*	*100.0*	*129.0*
Butter	Mill. lbs.	420.1	531.5	624.8	769.8	180	5	....	...	67.2	85.1	100.0	123.2
Cheese	Mill. lbs.	282.0	317.1	311.1	370.3	43	1	....	...	90.7	102.0	100.0	119.0
Condensed and evaporated milk	Mill. lbs.	186.9	308.5	494.8	873.4	34	1	....	...	37.8	62.3	100.0	176.5
Slaughtering and meat packing	....	....	....	....	....	....	...	*164*	*40*	*81.0*	*90.8*	*100.0*	*101.2*
Meat, fresh and cured	Mill. lbs.	7981	8772	9719	9677	919	13	....	...	82.1	90.3	100.0	99.6
Lard and lard compounds	Mill. lbs.	1020	1169	1244	1516	134	2	....	...	82.0	93.9	100.0	121.8
Hides and skins, cattle and calf	Mill. lbs.	336.0	456.4	504.6	434.5	68	1	....	...	66.6	90.5	100.0	86.1
Flour-mill and gristmill products	....	....	....	....	....	....	...	*116*	*30*	*92.2*	*95.9*	*100.0*	*104.6*
Wheat flour	Mill. bbls.	99.8	104.0	105.8	116.4	550	8	....	...	94.3	98.3	100.0	110.0
Corn meal and corn flour	Mill. bbls.	27.84	23.62	21.55	16.33	67	1	....	...	128.7	109.3	100.0	75.5
Bran, middlings, feed, and offal	Thous. tons	7157	7925	9236	9420	230	3	....	...	77.5	85.8	100.0	102.0
Beet sugar	....	....	....	....	....	....	...	*21*	*5*	*16.3*	*50.6*	*100.0*	*148.2*
Beet sugar	Thous. sh. tons	81.7	253.9	501.7	743.5	46	1	....	...	16.3	50.6	100.0	148.2
Cane sugar refining	....	....	....	....	....	....	...	*31*	*8*	*69.7*	*80.0*	*100.0*	*113.7*
Canning and preserving fruits and vegetables	....	....	....	....	....	....	...	*29*	*7*	*45.1*	*82.9*	*100.0*	*141.8*
Group II. — Textiles and their Products	....	....	....	....	....	....	...	**1,315**	**18**	**65.2**	**78.9**	**100.0**	**105.4**
Cotton manufactures	....	....	....	....	....	....	...	*257*	*13*	*71.3*	*79.7*	*100.0*	*108.3*
Woven goods	Mill. sq. yds.	4486	5057	6268	6811	447	21	....	...	71.6	80.6	100.0	108.7
Yarns manufactured for sale	Mill. lbs.	332.3	364.6	470.4	498.0	109	5	....	...	70.7	77.5	100.0	105.9
Thread	Mill. lbs.	15.91	17.16	23.70	26.51	21	1	....	...	67.2	72.4	100.0	111.9
Hosiery and knit goods	....	....	....	....	....	....	...	*90*	*5*	*51.0*	*70.8*	*100.0*	*107.0*
Hosiery	Mill. doz. prs.	29.90	44.19	62.83	75.16	69	10	....	...	47.6	70.3	100.0	119.5
Undergarments	Mill. doz.	16.86	21.16	27.81	28.03	84	12	....	...	60.6	76.0	100.0	100.8
Gloves and mittens	Thous. doz.	1899	2261	2528	2470	7	1	....	...	75.2	89.5	100.0	97.8
Hoods, sweaters, etc.	Thous. doz.	1095	1836	3329	3300	27	4	....	...	32.9	55.2	100.0	99.1
Silk goods	....	....	....	....	....	....	...	*89*	*5*	*54.6*	*70.8*	*100.0*	*123.1*
Broad, silks	Mill. yds.	87.6	124.9	185.7	216.0	108	15	....	...	47.2	67.3	100.0	116.3
Velvets, plushes, upholstery, and tapestries	Mill. yds.	10.30	11.58	13.08	25.91	7	1	....	...	78.8	88.5	100.0	198.0
Other silk goods	Thous. lbs.	4633	4341	5356	7240	25	4	....	...	86.5	81.1	100.0	135.2
Woolen and worsted goods	....	....	....	....	....	....	...	*146*	*7*	*67.3*	*82.5*	*100.0*	*99.1*
All-wool woven goods	Mill. sq. yds.	216.4	260.6	322.9	323.0	220	16	....	...	67.0	80.7	100.0	100.0
Union, or cotton mixed, woven goods	Mill. sq. yds.	57.33	63.20	37.45	46.24	14	1	....	...	153.1	168.8	100.0	123.5
Cotton warp woven goods	Mill. sq. yds	152.9	182.1	210.3	196.2	62	4	....	...	72.7	86.6	100.0	93.3
Yarns and tops	Mill. lbs.	96.2	118.1	145.4	141.6	103	8	....	...	66.2	81.2	100.0	97.4
Carpets and rugs, other than rag	....	....	....	....	....	....	...	*32*	*2*	*94.1*	*101.8*	*100.0*	*81.6*
Carpets and rugs	Mill. sq. yds.	76.41	82.67	81.22	66.34	67	1	....	...	94.1	101.8	100.0	81.6
Cordage, twine, and jute and linen goods	....	....	....	....	....	....	...	*20*	*1*	*68.0*	*82.5*	*100.0*	*122.3*
Rope and binder twine, exclusive of cotton rope	Mill. lbs.	305.8	[a]354.7	411.4	487.4	31	4	....	...	74.3	86.2	100.0	118.5
Twine other than binder	Mill. lbs.	36.2	[a] 52.4	75.8	105.2	9	1	....	...	47.8	69.1	100.0	138.8
Hats, fur felt	....	....	....	....	....	....	...	*26*	*1*	*63.0*	*87.4*	*100.0*	*70.9*
Group III. — Iron and Steel and their Products	....	....	....	....	....	....	...	**1,365**	**19**	**56.4**	**67.5**	**100.0**	**94.5**
Blast furnaces	....	....	....	....	....	....	...	*71*	*2*	*56.4*	*64.9*	*100.0*	*90.7*
Pig iron, including ferroalloys	Mill. long tons	14.45	16.62	25.65	23.27	388	1	....	...	56.4	64.9	100.0	90.7
Steel works, and rolling mills	....	....	....	....	....	....	...	*328*	*8*	*56.4*	*68.2*	*100.0*	*95.5*
Rolled, forged, and other classified iron and steel products	Mill. long tons	15.06	18.22	26.72	25.52	863	1	....	...	56.4	68.2	100.0	95.5
Group IV. — Lumber and its Remanufactures	....	....	....	....	....	....	...	**870**	**12**	**79.2**	**71.8**	**100.0**	**80.6**
Group V — Leather and its Finished Products	....	....	....	....	....	....	...	**323**	**4**	**80.8**	**94.1**	**100.0**	**100.0**
Leather tanned, curried, and finished	....	....	....	....	....	....	...	*80*	*8*	*89.4*	*99.8*	*100.0*	*95.8*
Sole leather	Mill. sides	15.47	17.94	17.81	18.08	88	4	....	...	86.9	100.8	100.0	101.5
Harness leather	Thous. sides	3445	4370	3946	2777	25	1	....	...	87.3	110.8	100.0	70.4
Cattle sides upper leather (other than patent)	Thous. sides	8141	6850	7947	8246	24	1	....	...	102.5	86.2	100.0	103.8
Boots and shoes, leather	....	....	....	....	....	....	...	*165*	*16*	*76.5*	*91.0*	*100.0*	*102.7*
Gloves and mittens, leather	....	....	....	....	....	....	...	*10*	*1*	*86.0*	*100.0*	*100.0*	*91.5*

[a] Interpolated, as described under individual series.

TABLE A, PART 2. — *Continued*

	Actual Items of Available Series					Weights Used and Their Bases				Relatives and Weighted Geometric Means			
	Units	1899	1904	1909	1914	Value of products in 1909	Weights of series	Value added by manufacture in 1909	Weights of industries and groups	1899	1904	1909	1914
						million dollars		*million dollars*					
Group VI. — Paper and Printing	....	....	....	....	....	....	...	**728**	**10**	**52.4**	**74.3**	**100.0**	**123.7**
Paper and wood pulp	....	....	....	....	....	....	...	*102*	*1*	*52.4*	*74.3*	*100.0*	*123.7*
Newspaper, in rolls or sheets	Thous. sh. tons	569	913	1168	1313	46	2	....	...	48.7	78.2	100.0	112.4
Book paper	Thous. sh. tons	323.2	476.5	694.9	934.9	55	2	....	...	46.5	68.5	100.0	134.5
Fine paper	Thous. sh. tons	112.7	146.8	198.2	247.8	29	1	....	...	56.9	74.0	100.0	125.0
Wrapping paper	Thous. sh. tons	535.2	644.3	763.1	881.9	42	2	....	...	70.1	84.4	100.0	115.6
Boards	Thous. sh. tons	365.6	520.8	831.6	1208.8	26	1	....	...	44.0	62.7	100.0	145.3
Miscellaneous papers	Thous. sh. tons	261.6	405.6	557.8	683.4	34	1	....	...	46.9	72.7	100.0	122.5
Group VII. — Liquors and Beverages	....	....	....	....	....	....	...	**488**	**4**	**65.4**	**86.7**	**100.0**	**118.4**
Group VIII. — Chemicals and Allied Products	....	....	....	....	....	....	...	**596**	**8**	**51.9**	**72.3**	**100.0**	**124.6**
Coke, not including gas-house coke	....	....	....	....	....	....	...	*32*	*2*	*50.0*	*63.8*	*100.0*	*87.9*
Coke	Mill. sh. tons	19.64	25.14	39.32	34.56	90	1	....	...	50.0	63.8	100.0	87.9
Fertilizers	....	....	....	....	....	....	...	*34*	*2*	*51.4*	*64.0*	*100.0*	*150.1*
Fertilizers	Thous. sh. tons	2887	3592	5618	8432	100	1	....	...	51.4	64.0	100.0	150.1
Gas, illuminating	....	....	....	....	....	....	...	*114*	*8*	*44.5*	*74.6*	*100.0*	*135.0*
Gas for sale	Bill. cu. ft.	67.1	112.5	150.8	203.6	139	1	....	...	44.5	74.6	100.0	135.0
Paint and varnish	....	....	....	....	....	....	...	*46*	*3*	*65.7*	*80.0*	*100.0*	*107.3*
White lead pigment	Mill. lbs.	254.7	240.1	248.0	279.3	[b] 11	1	....	...	102.7	96.8	100.0	112.7
White lead paint	Mill. lbs.	119.0	229.6	246.6	281.4	15	2	....	...	48.3	93.1	100.0	114.2
Zinc and other paints in paste form	Mill. lbs.	191.4	134.0	165.0	138.5	11	1	....	...	116.0	81.2	100.0	84.0
Paints in oil	Mill. gal.	17.44	22.76	34.28	40.75	31	3	....	...	50.8	61.2	100.0	119.0
Oleoresinous varnishes	Mill. gal.	14.80	17.32	18.69	17.80	18	2	....	...	79.3	92.8	100.0	95.3
Petroleum refining	....	....	....	....	....	....	...	*38*	*2*	*48.2*	*57.3*	*100.0*	*143.7*
Naphthas and lighter products	Mill. bbls.	5.62	5.81	10.81	29.20	40	1	....	...	52.0	53.7	100.0	270.0
Illuminating oils	Mill. bbls.	25.17	27.14	33.50	38.71	95	3	....	...	75.1	81.0	100.0	115.5
Fuel oils	Thous. bbls.	6095	7209	34034	74682	36	1	....	...	17.9	21.2	100.0	219.4
Lubricating oils	Mill. bbls.	3.41	6.30	10.75	10.36	39	1	....	...	31.7	58.6	100.0	96.4
Chemicals and acids	....	....	....	....	....	....	...	*58*	*4*	*50.1*	*68.2*	*100.0*	*131.8*
Explosives	....	....	....	....	....	....	...	*17*	*1*	*44.3*	*74.0*	*100.0*	*98.8*
Oil, cottonseed, and cake	....	....	....	....	....	....	...	*28*	*2*	*55.7*	*81.1*	*100.0*	*135.2*
Turpentine and rosin	....	....	....	....	....	....	...	*20*	*1*	*131.7*	*106.7*	*100.0*	*90.7*
Group IX. — Stone, Clay, and Glass Products	....	....	....	....	....	....	...	**348**	**5**	**71.1**	**84.2**	**100.0**	**103.8**
Group X. — Metals and Metal Products other than Iron and Steel[c]	....	....	....	....	....	....	...	**348**	**5**	**51.9**	**73.4**	**100.0**	**104.0**
Group XI. — Tobacco Manufactures	....	....	....	....	....	....	...	**240**	**3**	**69.6**	**86.9**	**100.0**	**114.7**
Group XII. — Vehicles for Land Transportation	....	....	....	....	....	....	...	**255**	**4**	**28.2**	**52.6**	**100.0**	**185.5**

b. Computed by multiplying total production by the price per pound of the amount sold.
c. This group is represented by 5 series of materials, since products are not available.

all classes comprise carriages, wagons, public conveyances, sleighs and sleds, and automobiles "manufactured in establishments devoted primarily to the manufacture of carriages and wagons."[1] Children's carriages and sleds, are, however, excluded. *Steam and railroad cars.* The number of cars reported in this series covers those built by railroad repair shops as well as by car companies. For 1899, the figures also include electric railroad cars, which were not classified separately in that year.

DISTRIBUTION AND ADEQUACY OF DATA

As has been said, the series utilized in this study refer either to materials used by, or to products of manufacturing industries; and the items of the series are in terms of physical units — tons, barrels, yards, etc. The actual items of all the series used in the computation of the indices of the physical volume of production for manufacture are given in Table A, Parts 1 and 2. In that table the series are classified according to industrial group, specific industry, and materials or products. Part 1 of the table presents all of the series relating to materials and, in addition, those series relating to products of industries for which materials are not available; these series constitute the data for *indices based on materials supplemented by products.* Part 2 of the table presents series of manufactured products for all the industries of Part 1 (except Group X) which are represented by materials used; these products series, together with the products series given in Part 1 and the materials series of Group X (for which group alone products are not available), constitute the data for *indices based on products*.

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[1] *Abstract of Manufactures*, 1915, p. 229, Table 148, footnote 3.

We have, then, two sets of data, (1) materials supplemented by products, and (2) products. From each set indices of the physical volume of production for manufacture are computed. The *first set* of data is composed of 83 series, of which 50 refer to materials and 33 refer to products. These series represent 61 industries; 42 of the industries are represented by materials (including the 22 industries of Group X as well as the 20 industries of other groups), and 19 are represented by products.

The *second set* of data is composed of 88 series, of which 83 refer to products and 5 refer to materials. These series represent 61 industries; 39 of the industries are represented by products and 22 (the industries of Group X) are represented by materials. The distribution of series and industries, among the fourteen groups of the census of manufactures, is given in Table B.

TABLE B. — DISTRIBUTION OF THE DATA USED IN THE INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE FOR CENSUS YEARS.

GROUP	FIRST SET OF DATA			SECOND SET OF DATA	
	Number of industries	NO. OF SERIES		Number of industries	Number of products series
		Materials	Products		
All groups covered	61	50	33	61	88
I. Food	6	9	3	6	13
II. Textiles	7	15	1	7	18
III. Iron and Steel	2	6	0	2	2
IV. Lumber	1	0	2	1	2
V. Leather	3	4	2	3	5
VI. Paper	1	4	0	1	6
VII. Liquors	2	0	2	2	2
VIII. Chemicals	9	7	10	9	22
IX. Stone, clay	2	0	6	2	6
X. Metals, non-ferrous	22 †	5	0	22 †	5 *
XI. Tobacco	3	0	3	3	3
XII. Vehicles	3	0	4	3	4
XIII. R.R. repair shops	0	0	0	0	0
XIV. Miscellaneous	0	0	0	0	0

* Number of materials series.

† Group X contains 28 industries of which at least 22 use, as materials, one or more of the five non-ferrous metals representing the group. Therefore the five series are assumed to represent 22 industries of Group X.

Table B shows that each group of industries except Groups XIII and XIV, Railroad Repair Shops and Miscellaneous Industries, respectively, is represented by 2 to 22 series, and by 1 to 22 industries. Table C, which supplements Table B, shows that for every industry covered, except two industries represented by materials and three by products, the series available aggregate in value from 60 to 100 per cent of the total cost of materials or value of products (as the case may be) for the industry in 1909 as reported by the census. The same table also shows that, for the twelve groups of

TABLE C. — MEASURES OF THE ADEQUACY OF THE DATA USED IN THE INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE FOR CENSUS YEARS.

(*Unit: one per cent*)

Group and industry	FOR INDUSTRIES		For groups[c]
	Materials[a]	Products[b]	
All Groups Covered	....	....	89[d]
I. Food	....	....	53
Butter	91	94	....
Slaughtering	80	84	....
Flour mills	(99)[e]	97	....
Beet sugar	(93)[e]	96	....
Cane sugar refining	(98)[e]	No series	....
Canning	No series	97	....
II. Textiles	....	....	50
Cotton	83	94	....
Hosiery	61	94	....
Silk goods	83	71	....
Woolen	76	98	....
Carpets	82	94	....
Cordage	78	69	....
Hats	No series	90	....
III. Iron and Steel	....	....	29
Blast furnaces	94	99	....
Steel works	78	88	....
IV. Lumber	....	....	56
Lumber	No series	(90–100)[e]	....
V. Leather	....	....	79
Leather, tanned	77	42	....
Boots and shoes	No series	97[f]	....
Gloves and mittens	No series	96	....
VI. Paper	....	....	14
Paper and wood pulp	62	87	....
VII. Liquors	....	....	92
Liquors, distilled	No series	(90–100)[e]	....
Liquors, malt	No series	(90–100)[e]	....
VIII. Chemicals	....	....	65
Coke	97	94	....
Fertilizers	13	96	....
Gas	65	83	....
Paint and varnish	27[f]	69[g]	....
Petroleum	76	89	....
Chemicals	No series	32	....
Explosives	No series	95	....
Oil	No series	(80–100)[e]	....
Turpentine	No series	100	....
IX. Stone, clay	....	....	38
Brick and tile	No series	44	....
Glass	No series	95	....
X. Metals, non-ferrous	....	....	(80–90)[e]
XI. Tobacco	....	....	98
Chewing, etc.	No series	(90–100)[e]	....
Cigars	No series	(90–100)[e]	....
Cigarettes	No series	(90–100)[e]	....
XII. Vehicles	....	....	76
Automobiles	No series	85	....
Carriages	No series	73	....
Steam r.r. cars	No series	77	....

a. Percentage that (1) cost of materials covered for each industry in 1909 bears to (2) total cost of materials for the industry as reported by the census.

b. Percentage that (1) value of products covered for each industry in 1909 bears to (2) total value of products for the industry in 1909 as reported by the census.

c. Percentage that (1) value added by manufacture in 1909 for the industries covered in each group bears to (2) total value added by manufacture in 1909 for complete groups as reported by the census.

d. Ratio of the value added by manufacture for the twelve groups represented in the index to that of the whole fourteen groups reported by the Census. The ratio of (1) the value added by manufacture ascribable to the products actually covered to (2) the total value added by manufacture for all fourteen groups, is estimated to be 40 or 45 per cent.

e. Exact data for this industry are lacking. The estimate given has been based on the best information at hand. *f*. Percentage based on 1914 data.

g. The percentage based on 1914 data is 71. Possibly this percentage, together with that quoted above, should be reduced by about 10 per cent on account of duplications.

industries, the percentage of (1) the value added by manufacture in 1909 for the industries covered in each group to (2) the total value added by manufacture in 1909 for complete groups as reported by the census, ranges from 50 to 98 per cent except in three cases. We estimate from this table that the ratio of (1) the value added by manufacture ascribable to the products actually covered to (2) the total value added by manufacture for all fourteen groups, is 40 or 45 per cent.

Analysis of our data, therefore, leads us to the conclusions, first, that our "sample" of manufacture is well distributed and, second, that the sample is large enough to constitute a reliable basis for the computation of indices of physical production for manufacture.

THE UNADJUSTED INDICES OF MANUFACTURE

The methods of deriving the unadjusted index have already been reviewed. The initial step is to express the actual items of each series as percentages of the item for 1909. These percentages, or relatives, are given in Table A. One noteworthy feature brought out by the relatives is the decline of such series as milk, goat and kid skins, carriages and wagons, corn meal and corn flour, cotton mixed woven goods, zinc paints, and turpentine and rosin; and the marked increase of such series as cream, beet sugar, canned vegetables, canned and dried fruits, petroleum, and automobiles.

Before the relatives for the series can be combined to give an index for the industry the proportionate importance of each series with respect to the industry has to be determined. The method adopted is to weight the various series in each industry according to cost in 1909, for materials, or value in 1909, for products. The weights assigned to the series and the weighted geometric averages of the series in each industry are given in Table A. These averages, printed in italics in Table A, will be referred to as the "industry index numbers."

Before the industry index numbers can be combined to give group index numbers the proportionate importance of each industry with respect to the group has to be determined. The method adopted is to weight the various industries in each group according to the "value added by manufacture" as reported by the census of 1909. The weights assigned to the industries and the weighted geometric averages of the industries in each group are given in Table A, the weights being printed in italics and the group indices in blackface type.

Before the group index numbers can be combined to give indices of physical production for manufacture in general, weights must be assigned to the groups. The groups, like the industries, are weighted according to the value added by manufacture in 1909 as shown in Table A, the figures being printed in blackface type.

The final index numbers for all groups of industries covered are as follows:

Based primarily on:	1899	1904	1909	1914
Materials	61.2	75.4	100.0	104.9
Products	61.2	75.4	100.0	106.2

Except in 1914 the two sets of indices are identical. This is a most unusual result that could not have occurred (even with 40 per cent of the products series in common) unless both materials and products fluctuated together very closely. The difference in 1914 is the result of higher group indices for products than for materials in Food and Kindred Products (110.3 and 105.8), Paper and Printing (123.7 and 119.2), and Chemicals and Allied Products (124.6 and 119.9). In all of these groups the products series are more extensive than the materials series and, on this ground, the indices based on products are to be preferred to those based on materials. Furthermore, judging the relative merits of the materials series *vs.* the products series by the three criteria, (1) constitution of the items of each series, (2) adequacy of sample, and (3) consistency of fluctuation of the series in each industry, there is only one industry (Leather, tanned, curried, and finished) for which the materials series are clearly the better. A comparison of (*a*) the group indices of manufacture based on materials supplemented by products, with (*b*) those based on products, the base being shifted to the geometric mean for the four census years, is given in Table D. In no case do the group index numbers differ

TABLE D. — COMPARISON OF (1) GROUP INDICES OF MANUFACTURE BASED ON MATERIALS SUPPLEMENTED BY PRODUCTS, WITH (2) THOSE BASED ON PRODUCTS, FOR CENSUS YEARS.*

(*Base: geometric mean for 1899, 1904, 1909, 1914 = 100*)

Groups	Base	1899	1904	1909	1914
All Groups					
Materials	83.4	73.4	90.4	119.9	125.9
Products	83.7	73.1	90.1	119.5	126.9
I. Materials	89.3	77.6	97.0	112.0	118.5
Products	91.3	78.9	95.7	109.5	120.8
II. Materials	86.0	77.9	90.2	116.3	122.6
Products	85.9	75.9	91.9	116.4	122.6
III. Materials	78.7	74.0	89.1	127.0	119.3
Products	77.5	72.8	87.1	129.0	121.9
IV. Materials	....	....	....	....	....
Products	82.3	96.2	87.2	121.5	97.9
V. Materials	91.9	85.3	99.7	108.8	108.0
Products	93.4	86.5	100.8	107.1	107.1
VI. Materials	81.2	62.1	89.2	123.1	146.8
Products	83.3	62.9	89.2	120.0	148.5
VII. Materials	....	....	....	....	....
Products	90.5	72.3	95.8	110.5	130.8
VIII. Materials	81.6	61.5	90.1	122.5	146.9
Products	82.7	62.8	87.4	120.9	150.7
IX. Materials	....	....	....	....	....
Products	88.8	80.1	94.8	112.6	116.9
X. Materials	79.3	65.4	92.6	126.1	131.1
Products	....	....	....	....	....
XI. Materials	....	....	....	....	....
Products	91.3	76.2	95.2	109.5	125.6
XII. Materials	....	....	....	....	....
Products	72.4	39.0	72.7	138.1	256.

* About 40 per cent (by value) of the series used in the index based o products are also used in the index based on materials supplemented b products.

by more than three per cent, and in no case do the final indices for all groups differ by as much as one per cent. The consistency of the results, therefore, confirms our conclusion, previously stated, that the data utilized constitute a reliable basis for an index of physical production for manufacture.

Two further points remain to be considered: first, would the choice of another year than 1909 for our weights have given significantly different results and, second, would the choice of a different basis for weighting industries and groups, such as number of employees or wages paid, instead of value added by manufacture, have affected our results appreciably. Examination of the figures for "value added" for the census years 1899, 1904, 1909, and 1914 reveals the fact that for only one or two industries, such as automobiles, and carriages and wagons, would the weights have been materially different if figures for another year had been used.

If weights for industries and groups had been based on number of employees or wages paid instead of on the value added by manufacture there would have been little difference in our results. Tables E and F show that the relative importance of the industries and groups is about the same according to any of the three criteria: (1) the value added by manufacture, (2) the average number of wage earners employed, and (3) the total wages paid. We conclude, then, that weights chosen proportional to value added by manufacture in 1909 are as reliable as any that could have been selected.

Table E. — Relative Importance of the Twelve Groups of Manufacturing Industries covered according to (1) the Value added by Manufacture, (2) the Average Number of Wage Earners Employed, and (3) the Total Wages Paid, in the Census Year 1909.

Groups	Weights used in the index*	Percentage Distribution according to			Rank according to		
		(1)	(2)	(3)	(1)	(2)	(3)
All groups covered..	102	100	100	100	....	....	....
I	10	10.2	7.1	7.0	4	4	5
II	18	17.9	24.7	20.0	2	1	2
III	19	18.6	17.6	21.4	1	2	1
IV	12	11.8	15.7	14.3	3	3	3
V	4	4.4	5.3	5.2	9	7	7
VI	10	9.9	7.1	8.2	5	5	4
VII	4	3.7	1.3	1.8	10	12	12
VIII	8	8.1	4.6	4.3	6	8	9
IX	5	4.7	5.9	6.4	7	6	6
X	5	4.7	4.3	5.0	8	9	8
XI	3	2.5	2.9	2.3	12	11	11
XII	4	3.5	3.5	4.1	11	10	10

* The weights used for groups of industries are round numbers proportionate to the percentage distribution of groups according to the value added by manufacture as shown in the adjacent column. Round number weights for the groups according to wages paid are, respectively, 7, 20, 21, 14, 5, 8, 2, 4, 6, 5, 2, 4; weights based on data for the years 1899, 1904, or 1914 would be practically the same.

Table F. — Relative Importance of the Industries covered according to (1) the Value added by Manufacture, (2) the Average Number of Wage Earners Employed, and (3) the Total Wages Paid, in the Census Year 1909.

Industry	Percentage Distribution of Industries within Groups according to		
	(1)[a]	(2)	(3)
I. Food	100	100	100
Butter	10	9	10
Slaughtering	40	43	47
Flour mills	30	19	20
Beet sugar	5	3	5
Cane sugar refining	8	6	7
Canning	7	20	11
II. Textiles	102	100	100
Cotton	39	44	41
Hosiery	15	15	14
Silk goods	15	12	12
Woolen	21	19	22
Carpets	6	4	5
Cordage	3	3	2
Hats	3	3	4
III. Iron and Steel	100	100	100
Blast furnaces	20	14	13
Steel works	80	86	87
IV. Lumber[b]			
V. Leather	100	100	100
Leather, tanned	32	24	25
Boots and shoes	64	72	71
Gloves and mittens	4	4	4
VI. Paper[b]			
VII. Liquors	100[c]	100	100
Liquors, distilled	8[c]	10	7
Liquors, fermented	92[c]	90	93
VIII. Chemicals	100	100	100
Coke	8	14	16
Fertilizers	8	9	8
Gas	32	18	21
Paint and varnish	12	7	9
Petroleum	8	7	10
Chemicals	16	13	16
Explosives	4	3	4
Oil	8	9	6
Turpentine	4	20	10
IX. Stone, Clay	100	100[d]	100[d]
Brick and tile	55[d]	57[d]	53[d]
Glass	45[d]	43[d]	47[d]
X. Metals, Non-Ferrous[e]			
XI. Tobacco	100	100	100
Chewing, etc.	35	16	13
Cigars	55	79	83
Cigarettes	10	5	4
XII. Vehicles	100	100	100
Automobiles	42	35	37
Carriages	33	36	33
Steam r. r. cars	25	29	30

a. The weights used for industries are proportionate to these percentages.
b. Only one industry covered in Groups IV and VI.
c. Excluding taxes. *d*. Based on figure for 1914.
e. Series for separate industries not available for Group X.

Comparison of the Unadjusted Index of Manufacture for Census Years with Other Series

The index of physical production for manufacture for census years is based upon more extensive and trust-

TABLE G. — COMPARISON OF THE INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE (BASED ON MATERIALS SUPPLEMENTED BY PRODUCTS) WITH ELEVEN OTHER SERIES FOR CENSUS YEARS

(Base: arithmetic average for 1899, 1904, 1909, 1914 = 100)

Series	Fixed Base Relatives (Arithmetic average for 1899, 1904, 1909, and 1914 = 100)				Link Relatives (The item for the preceding census year = 100)		
	1899	1904	1909	1914	1904	1909	1914
(1) Index of physical production for manufacture based on census data	**71.7**	**88.3**	**117.1**	**122.9**	**123.2**	**132.6**	**104.9**
(2) Value added by manufacture for all groups covered under (1)	66.5	85.6	116.0	132.0	128.7	135.5	113.7
(3) Value added by manufacture for all industries reported by the census	65.4	85.3	115.5	133.8	130.4	135.5	115.8
(4) Value of product for all industries deflated by B. L. S. index of wholesale prices of manufactures	74.7	89.1	109.3	126.9	119.3	122.7	116.1
(5) Total clearings outside New York City deflated by B. L. S. index of wholesale prices of all commodities	77.0	87.5	110.2	125.3	113.6	125.9	113.7
(6) Net ton miles of revenue freight moved							
a. Fiscal year ending June 30	61.4	86.7	108.7	143.3	141.2	135.7	121.8
b. Fiscal year beginning July 1	67.3	88.5	112.5	131.6	131.5	127.1	117.0
(7) Pig iron production	68.8	83.3	130.2	117.7	121.2	156.2	90.4
(8) Bituminous coal production	60.7	87.5	119.2	132.7	144.1	136.2	111.3
(9) Agriculture, index of physical production	85.2	98.9	100.8	115.0	116.1	101.8	114.2
(10) Mining, index of physical production	63.7	86.7	120.6	129.0	136.2	139.1	107.0
(11) Manufacture, uncorrected index based on annual data	65.9	88.2	118.9	127.0	134.0	134.8	106.8

worthy data than are at our disposal for intercensal years. It is interesting to compare the index which we have constructed for census years with several other series of statistics which have been used by various writers as annual indices of industrial productivity, with the unadjusted indices of physical production which Professor Day has presented in previous installments for agriculture and mining, and with his uncorrected index for manufacture based on annual data, presented in Part B of the present installment.

The various series used in the comparison, all expressed as percentages of their respective averages for the four census years, are given in Table G. The last three columns of that table give "link relatives," which are merely percentages obtained by dividing the items for each census year by the items for the preceding census year. The fixed base relatives enable us to compare the series for the entire period; the link relatives enable us to make a year-to-year comparison of fluctuations.

The point at issue in our comparison is this: what one of the series is "the closest fit" to our standard, the index of physical production for manufacture based on census data. We adopt as a measure of closeness of fit the sum of the squares of deviations of the items of each series from the items of the standard series for corresponding years. The series having the smallest "sum of squares of deviations" from the standard series "fits" the standard series closest according to the criterion which we have adopted.

Table H gives the list of eleven series "arrayed" in order of the sum of squares of deviations from the standard series, all items being percentages of a fixed base.

TABLE H. — THE RANK OF ELEVEN SERIES WITH REFERENCE TO "CLOSENESS OF FIT" TO THE INDEX OF PHYSICAL PRODUCTION FOR MANUFACTURE.*

Rank	Sum of squares of deviations from the Index (using fixed base)	Series number	Sum of squares of deviations from the Index (using link relatives)	Series number
1	56	(11)	130	(2)
2	78	(5)	177	(11)
3	90	(4)	179	(3)
4	117	(10)	209	(10)
5	122	(2)	211	(5)
6	131	(6b)	237	(4)
7	180	(3)	261	(6b)
8	225	(8)	486	(8)
9	228	(7)	622	(6a)
10	586	(6a)	758	(7)
11	610	(9)	1091	(9)

* See Table G for names of the series and items for census years.

The series most like the standard are, *in order of likeness*, the following:

Uncorrected indices for manufacture, based on annual data
Deflated outside bank clearings
Deflated value of all manufactured products as reported by the census
Index of physical production for mining
Value added by manufacture for the groups represented in the standard series
Net ton miles of revenue freight for the fiscal yea beginning July 1.

The result is illuminating. The index for manufactur based on annual data is the best, according to the stand ard adopted. Deflated outside clearings, deflated value of manufactured products and the mining index are all high up on the list. Mining, as might have been expected, is a good index of manufacturing activity.

The series most unlike the standard are, *in order of unlikeness*, the following:

Index of physical production for agriculture
Net ton miles of revenue freight for the fiscal year ending June 30
Pig-iron production
Bituminous coal production
Value added by manufacture for all industries reported by the census.

Crops do not fluctuate with manufacture and mining; pig-iron and coal production, and freight movement are not good indices of manufacturing activity over a period of years.

Another comparison remains to be considered: the closeness with which the year-to-year fluctuation of the various series conform to the standard. Table H gives the list of eleven series arrayed in order of the sum of squares of deviations from the standard series, all items being percentages of the items for the preceding census year. The series most like the standard are, *in order of likeness*, the following:

Value added by manufacture for the groups represented in the standard series
Uncorrected indices for manufacture based on annual data
Value added by manufacture for all industries reported by the census
Index of physical production for mining
Deflated outside bank clearings
Deflated value of all manufactured products as reported by the census.

The index for manufacture based on annual data moves down to second place in the list, value added by manufacture for 12 and 14 groups, respectively, takes first and third places, and the mining index is fourth. It is evident that "value added by manufacture" is an excellent index of physical production for manufacture *during short intervals when price changes are not great.*

The series most unlike the standard according to the year-to-year comparison are, *in order of unlikeness*, the following:

Index of physical production for agriculture
Pig-iron production
Net ton miles of revenue freight for the fiscal year ending June 30
Bituminous coal production
Net ton miles of revenue freight for the fiscal year beginning July 1.

Again, according to this test, crops, freight movement, and pig-iron and coal production are poor indices of manufacture.

The foregoing analysis indicates that if we adopt the index based on census data as the "standard" and apply two tests for "closeness of fit," considering both tests, the annual index for manufacture is the best index of physical production for manufacture among the eleven series considered.

B. THE INDEX BASED UPON ANNUAL DATA 1899–1919

RELATION OF THE ANNUAL INDEX TO THE CENSUS INDEX

As a result of the analysis of census data, a reliable index of the physical volume of manufacture has been obtained for the census years 1899, 1904, 1909, and 1914. The problem is now to make the index continuous by years from 1899 to 1919. Two steps are involved: (1) an analysis of the annual series along the lines already followed in the case of census data; (2) a correction of the results thus obtained to make them conform to the index already derived for census years.

The index based upon annual data is corrected on the ground that the index based upon census reports affords a more accurate record of changes in the physical volume of manufacture for census years. In the first place, the census index rests upon a substantially larger body of information. The federal census of manufactures is a remarkably complete register of factory industry in the United States. For intercensal years no equally exhaustive records are available. In the construction of the index based upon census data, over eighty separate series have been utilized. The index from annual data rests upon only thirty-three. In the second place, the census series are not only more numerous but are more directly indicative of the actual results of manufacture. It has been possible in the analysis of census data to construct an index of the physical volume of manufacture based entirely upon series of manufactured products. In the construction of the index from annual data, no such opportunity is offered. The majority of the annual series are of materials used. The annual index rests upon the assumption that fluctuations in the volume of manufacturing output will correspond fairly closely to fluctuations in the amount of materials consumed. The assumption is reasonably safe, and the reliability of the index based upon annual data is not seriously impaired by the necessity of using series of materials consumed rather than of products turned out.[1] Nevertheless, an index based upon series of products manufactured would appear to possess somewhat higher standing. For this reason, as well as because the census data are so much more abundant, the index based upon annual data is corrected so as to bring it entirely into line with the index based upon census data for census years.

MATERIAL UTILIZED

The material utilized in the construction of the annual manufacturing index consists of thirty-three series, continuous in practically all cases from 1899 to 1919. These thirty-three annual series vary widely in character. Some show products manufactured, some raw materials consumed; others raw materials imported, and still others raw materials produced. All serve to indicate directly or indirectly the volume of manufacturing output. The manner in which they serve this purpose appears more clearly as the series are examined individually with reference to the groups of industries the series are taken to represent.

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[1] This is completely demonstrated by Professor Persons in the analysis to be found on p. 322.

GROUP I. — FOOD

Slaughtering and Meat Packing: This industry is represented by three series; namely, the total receipts of *cattle*, *hogs*, and *sheep* at the seven principal interior markets — Chicago, Kansas City, Omaha, St. Louis, Sioux City, St. Joseph, and St. Paul. The business of slaughtering and meat packing is conducted in the United States upon such a large scale and is so highly localized, that the three series of live-stock receipts appear to reflect satisfactorily the volume of production for the entire industry.

Flour-mill and Gristmill Products: Wheat consumption is the series used for this industry. The series has been compiled by adding imports of the calendar year to domestic production and subtracting exports from this total. In using the import and export data, both wheat and wheat flour are included, the flour in barrels being reduced to grain in bushels by making one barrel equal to four and one-half bushels. The series as constructed is defective in ignoring the varying stocks carried over from one year to another. There seems to be no way, however, of incorporating stocks in the compilation, and the series even without recognition of stocks appears to reflect fairly closely the fluctuating activity of the milling industry.

Beet Sugar; Cane Sugar Refining: These two industries of the census classification are represented by a single series showing the total amount of *sugar* imported from non-contiguous United States and foreign countries in fiscal years and that produced in continental United States during preceding crop years. Sugar produced was obtained by adding to the production of beet sugar (chiefly refined), that of cane sugar (chiefly raw) as reported for Louisiana and "other states." In the construction of the annual index for the food and kindred products group, this single series for sugar supply is given a weight equal to the sum of the weights of the two series — "beet sugar" and "cane sugar refining" — which are used in the construction of the census index.

GROUP II. — TEXTILES

Cotton Manufactures; Hosiery and Knit Goods: These two important textile industries are represented by a single series — *cotton* consumption. Domestic and foreign cotton and linters are included in the series. The items of the series relate to the twelve months during which the crop of the specified year was marketed and not to the calendar year indicated. No allowance for this fact has, however, seemed necessary.

Silk Goods, Including Throwsters: The series used for this industry consists of imports of *unmanufactured silk* for the calendar year. All forms of unmanufactured silk are included: cocoons; silk, raw or as reeled from the cocoon; silk waste. Since no raw silk is produced in the United States, imports of unmanufactured silk represent the total flow of basic raw material into the silk manufacturing industry. Variations in accumulated raw material stocks, however, are not taken into account. To this extent the series is only an approximate indication of the physical volume of production year by year.

Woolen and Worsted Goods; Carpets and Rugs, Other Than Rag: Both of these industries are represented by a series showing *wool* consumption in the United States by fiscal years. The series is said to show the amount of "wool retained for consumption." The wool clip of the year reaches the market during the governmental fiscal year. The series item for each year is obtained by subtracting the exports from the imports of the fiscal year ended June 30th and then adding to this figure the wool clip of the preceding calendar year. The aggregate thus obtained is stated to be the net supply of new wool available for manufacture.

Cordage and Twine and Jute and Linen Goods: The series used for this industry consists of imports of unmanufactured *fibers and textile grasses.* Hemp, flax, istle, jute and jute butts, kapok, Manila, New Zealand flax, and sisal grass are all included. Since practically the entire supply of these materials is imported, the series constitutes a satisfactory index of raw-material consumption and hence of manufacturing activity. Like some of the other series, however, it is defective in making no allowance for fluctuations in the stocks of raw material held in the United States.

GROUP III. — IRON AND STEEL

This entire industry is represented by a single series giving the approximate consumption of *pig iron* in long tons. Prior to 1905 stocks were considered in obtaining the consumption figures: to the yearly production of pig iron, stocks unsold on January 1st were added and stocks on hand December 31st deducted; then imports of pig iron for the calendar year were added and exports subtracted. In 1905 the collection of unsold stock statistics was discontinued and since that year the approximate consumption series has been secured by adding imports to production and then deducting exports.

GROUP IV. — LUMBER

Lumber production alone is assumed to be fairly representative of production as a whole in this industry. The series used gives the estimated total yearly cut of lumber in board feet. The items of this series are calculated annually from the actual cut of lumber reported by the varying number of active mills making returns. The series of the cut actually reported is not satisfactory because of fluctuations in the number of mills reporting from year to year. The estimates of total cut are supposed, however, to take this factor into account.

GROUP V. — LEATHER

GROUP VI. — PAPER

No satisfactory annual series of either materials or products are available for these two groups of industries for the period 1909 to 1919.

GROUP VII. — LIQUORS

Liquors, Distilled: The series used for this industry shows the total quantity of *distilled spirits* (other than fruit brandy) produced in the United States in the fiscal years ended June 30th. The series is practically identical with that employed for this industry in the construction of the index for census years. The use of fiscal-year figures undoubtedly introduces an error, but the error is apparently unavoidable and is not so large as to suggest the abandonment of the series.

Liquors, Malt: This industry is represented by the same series as in the construction of the index for census years. The items give the yearly production of *fermented liquors* in the United States by fiscal years ended June 30th.

GROUP VIII. — CHEMICALS

The numerous industries of this group are represented by five series, two of which are indicative of production in the same industry.

Coke, not Including Gas-house Coke: The series used gives in short tons the total production of *by-product coke.* Many products important for the chemical industries are obtained from the ovens in which by-product coke is produced. Among these important materials are numerous coal-tar products, ammonia sulphate for fertilizers, and raw material for the manufacture of explosives, dyes, and ammonia. The production of by-product coke is thus rather widely indicative of the manufacture of numerous important chemical products. Nevertheless it has been thought best not to assign to the coke series any greater weight than is possessed in the census analysis by the single industry of coke production.

Paint and Varnish: Two series are used in setting up the index for this industry. The first of the series consists of the total production of *flaxseed* in the United States by crop years. The growing of flaxseed is but one step removed from the production of linseed oil, since the seed is almost wholly consumed in the manufacture of oil to be used as a base for such commodities as paint, varnish, and printing ink. No comment on this series is required since the series has already been discussed in the course of the construction of the index for agricultural output. The production of *zinc and lead pigments* is the other series employed to represent the paint and varnish industry. This series gives in short tons the quantity of domestic zinc and lead pigments made directly from ores and sold in the United States.

Petroleum refining: The series used for this industry is the marketed production of *crude petroleum* in barrels of 42 gallons. The series is identical with that employed in the construction of the mining index. A detailed account of the compilation of the series is to be found in Part II of the present study.

Cottonseed Oil and Cake: The volume of production in this industry is satisfactorily indicated by the number of short tons of *cottonseed* crushed each year at active cottonseed oil mills. In compiling these statistics of cottonseed consumption a varying number of sources of information have been used by the government agencies, and the series is more a reasonable approximation than an actual record of the facts.

GROUP IX. — STONE, CLAY AND GLASS PRODUCTS

Brick and Tile, Terra-cotta and Fire-clay Products: The series for this industry is the total quantity of *raw clay* mined and sold in the United States in short tons. Brick clay is among the varieties included.

Glass: The glass producing industry is represented in the construction of the manufacturing index by a series giving the annual production of *glass sand* in the United States in short tons. The series is not available for years before 1902.

Lime: The record of production in this industry is directly available in the form of annual items giving in short tons the quantity of *lime* burned and sold in the United States. The series begins with the year 1904 but items for the years 1899 to 1903 have been estimated from the published reports of the value of lime produced during these five years.

GROUP X. — METALS, NON-FERROUS

The five series used in the construction of the index for this group are also used in the construction of the index for this group for census years. The comments made upon these series in Section A consequently serve as the detailed explanation of this part of the material used in the construction of the annual index.

The series give the consumption of the principal metals used as raw material in the metal industries other than iron and steel. The series consist of: (1) the total quantity of *gold* (in both new and old material) in fine ounces furnished for use in manufactures and the arts; (2) the corresponding series for *silver;* (3) apparent consumption of new refined *copper;* (4) apparent consumption of primary *lead;* (5) apparent consumption of primary *zinc.*

The methods of obtaining the copper, lead, and zinc series differ considerably. The copper consumption data are obtained by subtracting from total refinery output the net exports of the year, and then adding refinery stocks at the beginning of the year and subtracting such stocks at the end of the year. An inconsistency in the copper series appears in the failure prior to 1906 to reduce data to refined metal. The zinc series is secured by adding to the year's production of the metal imports of the year and stocks at bonded warehouses and at smelters on January 1st, and subtracting exports

TABLE XXI. — ANNUAL SERIES INDICATIVE OF PHYSICAL PRODUCTION FOR GROUPS OF MANUFACTURES, 1899–1919

Year	I. FOOD AND KINDRED PRODUCTS					II. TEXTILES AND THEIR PRODUCTS				III IRON AND STEEL	IV LUMBER	VII. LIQUORS AND BEVERAGES		VIII. CHEMICALS AND ALLIED PRODUCTS				
		LIVE STOCK Receipts at seven cities													PAINTS AND VARNISH			
	Wheat, apparent consumption	Cattle	Hogs	Sheep	Sugar, total supply	Cotton (including linters), apparent consumption	Wool, apparent consumption	Fibers and textile grasses (including flax), imports of unmanufactured	Silk, imports of unmanufactured	Pig iron, approximate consumption	Lumber, estimated cut	Liquors,* distilled production	Liquors,* fermented production	Cotton seed, used in manufacture	Zinc and lead pigments, production	Flaxseed, production	Petroleum, marketed production	Coke, by-product
	million bushels	*million animals*	*million animals*	*million animals*	*million lbs.*	*thousand bales of 500 lbs.*	*million lbs.*	*thous. long tons*	*million lbs.*	*million long tons*	*million M bd.ft.*	*million gals.*	*million bbls.*	*thous. sh. tons*	*thous. sh. tons*	*million bushels*	*mill. bbls. of 42 gals.*	*million sh. tons*
1899	353.9	6.75	17.84	6.83	4610	3672	329.4	231.4	13.58	13.78	35.08	97.1	36.58	2479	40.1	19.98	57.1	0.91
1900	339.9	7.18	18.57	7.06	4516	3687	420.2	233.7	9.67	13.18	....	105.5	39.33	2415	48.8	17.59	63.6	1.08
1901	482.4	7.71	20.34	7.80	5599	3604	388.4	256.8	13.64	16.23	....	124.5	40.52	3154	49.0	25.32	69.4	1.18
1902	458.5	8.38	17.29	9.18	5034	4080	465.9	324.6	15.65	18.44	....	128.6	44.48	3269	61.3	29.28	88.8	1.40
1903	477.2	8.88	16.78	9.68	6399	4187	490.0	289.1	14.52	18.04	....	141.8	46.65	3241	71.7	27.30	100.5	1.88
1904	492.1	8.69	17.78	9.60	5734	3981	458.0	298.1	20.78	16.68	43.00	134.3	48.21	3345	75.6	23.40	117.1	2.61
1905	623.6	9.20	18.99	10.57	6099	4523	538.4	324.2	19.47	23.16	43.50	147.8	49.46	3131	82.4	28.48	134.7	3.46
1906	608.5	9.37	19.22	10.86	6545	4877	491.5	301.9	18.66	25.60	46.00	145.7	54.65	3844	90.8	25.58	126.5	4.56
1907	474.5	9.59	19.54	9.86	7133	4974	499.1	315.6	17.67	26.20	46.00	168.6	58.55	2565	95.2	25.85	166.1	5.61
1908	513.4	8.83	22.86	9.83	6635	4493	418.6	306.9	19.94	15.98	42.00	127.1	58.75	3670	75.1	25.80	178.5	4.20
1909	645.6	9.19	18.42	10.28	7381	5199	574.0	366.6	24.71	25.91	44.51	133.5	56.30	3269	87.5	25.86	183.2	6.26
1910	574.1	9.12	14.85	12.37	7551	4759	588.0	273.3	25.26	27.41	44.50	156.2	59.49	4106	75.2	12.72	209.6	7.14
1911	539.8	8.63	19.93	13.52	7325	4713	450.8	283.5	26.05	23.68	43.00	175.4	63.28	4921	80.6	19.37	220.4	7.85
1912	623.9	8.06	19.77	13.73	7964	5400	510.2	403.9	29.59	29.58	45.00	178.2	62.18	4580	106.5	28.07	222.9	11.12
1913	609.8	7.90	19.92	14.04	8301	5867	494.9	391.1	34.20	30.85	44.00	185.4	65.32	4848	97.6	17.85	248.4	12.72
1914	661.7	7.18	18.27	13.27	8891	5943	542.7	395.5	30.79	23.36	40.50	174.6	66.19	5780	106.8	13.75	265.8	11.22
1915	754.6	7.96	21.03	11.16	9229	6087	591.0	393.2	37.13	29.78	38.00	132.1	59.81	4202	141.4	14.03	281.1	14.07
1916	427.0	9.32	25.35	11.64	9646	7327	821.8	492.7	40.87	38.96	40.00	249.1	58.63	4479	135.6	14.30	300.8	19.07
1917	504.3	11.24	20.94	10.02	9737	7721	656.9	399.8	43.43	38.04	36.00	277.8	60.82	4252	140.6	9.16	335.3	22.44
1918	730.3	12.94	25.46	12.06	8679	7555	662.9	382.6	48.72	38.82	32.00	173.5	50.27	4479	135.7	13.37	355.9	26.00
1919	681.8	12.15	25.28	14.31	9845	6289	721.2	327.3	55.52	30.80	34.00	99.0	27.71	4180	145.2	8.92	377.7	25.17

Figures are for fiscal years ending June 30.

of the year and stocks at bonded warehouses and at smelters on December 31st. The lead series since 1907 is compiled on the same basis as the zinc series except that stocks at smelters are not included. Before 1907, upon the other hand, the lead consumption series includes domestic stocks. Only refined metal is included in the lead series prior to 1907, while since 1907 the series comprises all forms of lead — lead in ore, base bullion, pigs and bars. Clearly, the series are neither entirely complete nor perfectly continuous. The omission of dealers' stocks and secondary consumption is especially regrettable. The series appear to yield, nevertheless, reasonably trustworthy yearly relatives, and there is no reason to question seriously the results obtained for this group of industries.

GROUP XI. — TOBACCO

The three annual series used in the construction of the index for this group of industries are the same as those employed in the construction of the index for census years.

Tobacco, Chewing and Smoking, and Snuff: The series for this industry is of *tobacco and snuff* manufactured in the United States during calendar years. The varieties of tobacco include plug, twist, fine cut, and smoking.

Tobacco, Cigars: Annual aggregate production of *cigars* has been reported ever since 1881. Beginning with 1899, production has been subdivided into the manufacture of cigars weighing more than three pounds per thousand and those weighing less. Since the great bulk of cigars fall into the heavier class, the series of cigars weighing more than three pounds per thousand has been taken.

Tobacco, Cigarettes: The government reports of the manufacture of *cigarettes* separate those weighing not more than three pounds per thousand from those weighing more than three pounds. Since the manufacture of the cigarettes weighing three pounds or less per thousand is much the more important subdivision, this part of the production of cigarettes has been used in the construction of the manufacturing index.

GROUP XII. — VEHICLES

Automobiles: Two annual series are available for this industry: the production of (1) *passenger automobiles*, and (2) *motor trucks*. So rapid has been the growth of the industry that the data are hardly significant before 1904. They are continuous annually only since 1909 in the case of passenger automobiles and only since 1911 in the case of motor trucks. In the construction of the index for the industry, however, it has been found necessary to estimate production for both series from 1899 to

TABLE XXI. — ANNUAL SERIES INDICATIVE OF PHYSICAL PRODUCTION FOR GROUPS OF MANUFACTURES, 1899–1919

Year	IX. STONE, CLAY, AND GLASS PRODUCTS				X. METALS AND METAL PRODUCTS OTHER THAN IRON AND STEEL					XI. TOBACCO MANUFACTURES			XII. VEHICLES FOR LAND TRANSPORTATION			
													STEAM RAILROAD CARS		AUTOMOBILES	
	Cement§ (Portland), production	Lime, burned and sold in U. S.	Glass sand, production	Clay (raw), production	Copper, apparent consumption	Zinc (primary), apparent consumption	Lead (primary), apparent consumption	Gold, used in manufactures and arts	Silver, used in manufactures and arts	Tobacco and snuff, production	Cigars,† production	Cigarettes,‡ production	Freight cars, production	Passenger cars, production	Passenger automobiles, production	Auto trucks, production
	million bbls.	*thous. sh. tons*	*thous. sh. tons*	*thous. sh. tons*	*million lbs.*	*thous. sh. tons*	*thous. sh. tons*	*thous. fine oz.*	*million fine oz.*	*million lbs.*	*billion cigars*	*billion cigarettes*	*thous. cars*	*one car*	*thous. cars*	*thous. cars*
1899	5.65	1940	....	843	....	124.6	226.3	960	12.13	294.6	4.910	3.74	119.9	1305	4	0.1
1900	8.48	1888	....	1222	357	99.4	269.3	1072	13.22	300.7	5.566	3.25	115.6	1636	....	....
1901	12.71	2279	....	1367	383	141.7	271.9	1155	14.13	313.9	6.139	2.72	137.0	2055	....	....
1902	17.23	2593	943	1455	552	152.7	332.5	1339	19.35	347.6	6.232	2.96	162.6	1948	....	....
1903	22.34	2571	823	1642	526	154.4	300.2	1406	19.97	351.5	6.806	3.36	152.8	2007	....	....
1904	26.51	2708	859	1509	482	180.9	319.5	1387	20.48	353.7	6.640	3.43	60.8	2144	21	0.4
1905	35.25	2984	1060	1806	581	200.4	347.0	1607	23.70	367.5	6.748	3.67	163.3	2500	....	....
1906	46.46	3198	1089	2027	677	220.8	376.3	1893	21.85	391.3	7.148	4.50	233.4	3084	....	....
1907	48.78	3093	1187	2184	488	227.0	360.7	1970	24.37	387.8	7.302	5.26	275.0	5353	....	....
1908	51.07	2767	1094	1724	480	214.2	318.6	1523	23.85	407.5	6.489	5.74	68.0	1637	....	....
1909	64.99	3485	1104	2160	689	270.7	368.7	1820	27.90	431.4	6.668	6.82	86.9	2749	128	3.3
1910	76.55	3506	1461	2389	732	245.9	379.2	2022	24.79	447.3	6.810	8.64	170.8	4288	181	....
1911	78.53	3393	1539	2183	682	280.1	384.8	1975	32.01	424.1	7.049	10.47	62.2	3466	199	10.7
1912	82.44	3529	1465	2530	756	340.3	388.1	2128	29.94	435.5	7.044	13.17	142.4	2960	356	22.0
1913	92.10	3595	1792	2648	812	295.4	419.5	2219	30.99	443.9	7.572	15.56	185.7	2779	462	23.5
1414	88.23	3381	1620	2210	620	299.1	448.9	2202	29.31	440.9	7.174	16.86	98.1	3366	544	25.4
1915	85.92	3623	1884	2363	1044	364.6	425.4	1830	29.97	442.4	6.599	17.96	70.1	1866	819	74.0
1916	91.52	4073	2018	2933	1430	458.4	477.4	2470	32.10	466.2	7.042	25.29	129.4	1802	1494	90.0
1917	92.81	3786	1943	3114	1316	413.6	513.3	2560	27.04	483.0	7.560	35.33	139.6	1955	1741	128.2
1918	71.08	3206	2173	2976	1662	423.4	493.3	2536	36.25	497.1	6.991	37.89	108.0	1572	926	227.2
1919	80.29	2976	1690	2363	1160	304.0	456.0	3435	....	430.0	6.857	44.77	156.8	391	1658	316.4

† Weighing more than 3 pounds per thousand. ‡ Weighing not more than 3 pounds per thousand.

§ Not included in the index because not considered representative of the group.

1909 by interpolating on the line of secular trend as determined by the more recent annual data and the census data for 1904, 1909, and 1914.

Steam and Electric Railroad Cars: The two series used for this industry show the production of (1) *passenger cars*, and (2) *freight cars* in the United States from 1899 to 1919 continuously. From 1905 to 1912 both series as published include Canadian production. Consequently deductions have been made on the basis of the data of other years, and an estimated production for the United States thus obtained.

GROUP XIII. — RAILROAD REPAIR SHOPS
GROUP XIV. — MISCELLANEOUS INDUSTRIES

No series have been obtained for these two groups in the construction of either the census or the annual index.

The fourteen groups of industries recognized in the census classification are thus covered in varying degrees by the available records of physical production. Two of the groups are omitted in the construction of the census index; four in the construction of the annual index. The majority of the groups, however, are represented by series which afford a satisfactory basis for the development of reliable yearly group indices. Of course, the census index rests upon a larger body of material. It is for this reason that the annual index is corrected to conform to the census index for census years. As a result of this correction, the annual data really determine only the year to year fluctuations of the index. Used in this way, the thirty-three series which serve as a basis of the annual index appear to be entirely adequate.

SOURCES OF INFORMATION

(a) *General*

The majority of the annual series used in the construction of the index of manufacture are obtained from regular reports of offices and agencies of the federal government. The most important of the reports are: The *Yearbook* of the Department of Agriculture; the annual report on *Mineral Resources* of the United States Geological Survey; the *Monthly Summary of Foreign Commerce* of the Bureau of Foreign and Domestic Commerce; and the annual reports of the Commissioner of Internal Revenue. Special bulletins of the Department of Agriculture and the Bureau of the Census also contribute important material. The non-governmental sources from which important data are drawn are the *Railway Age* and the publications of the American Iron and Steel Institute, the National Association of Wool Manufacturers, and the National Auto-

TABLE XXII. — RELATIVE ANNUAL SERIES INDICATIVE OF PHYSICAL PRODUCTION FOR GROUPS OF MANUFACTURES, 1899–1919

(*Base: items for 1909 = 100*)

Year	I. FOOD AND KINDRED PRODUCTS					II. TEXTILES AND THEIR PRODUCTS				III IRON AND STEEL	IV LUMBER	VII. LIQUORS AND BEVERAGES		VIII. CHEMICALS AND ALLIED PRODUCTS				
		LIVE STOCK Receipts at Seven Cities													PAINTS AND VARNISH			
	Wheat, apparent consumption	Cattle	Hogs	Sheep	Sugar, total supply	Cotton (including linters), apparent consumption	Wool, apparent consumption	Fibers and textile grasses (including flax), imports of unmanufactured	Silk, imports of unmanufactured	Pig Iron, approximate consumption	Lumber, estimated cut	Liquors,* distilled production	Liquors,* fermented production	Cotton seed, manufactured	Zinc and lead pigments, production	Flaxseed, production	Petroleum, marketed production	Coke, By-product
	million bushels	*million animals*	*million animals*	*million animals*	*million lbs.*	*thousand bales of 500 lbs.*	*million lbs.*	*thous. long tons*	*million lbs.*	*million long tons*	*million M bd. ft.*	*million gals.*	*million bbls.*	*thous. sh. tons*	*thous. sh. tons*	*million bushels*	*mill. bbls. of 42 gals.*	*million sh. tons*
1909	**645.6**	**9.19**	**18.42**	**10.28**	**7381**	**5199**	**574.0**	**356.1**	**24.71**	**25.91**	**44.51**	**133.5**	**56.30**	**3269**	**87**	**25.86**	**183.2**	**6.26**
1899	54.8	73.4	96.8	66.4	62.5	70.6	57.4	63.2	55.0	53.2	78.8	72.7	64.9	75.8	45.8	77.3	31.1	14.5
1900	52.7	78.1	100.8	68.7	61.2	70.9	73.2	63.7	39.2	50.9	....	79.0	69.9	73.9	55.8	68.1	34.7	17.2
1901	74.7	83.9	10.4	75.8	75.9	69.3	67.6	70.0	55.3	62.7	....	93.3	72.0	96.5	56.0	97.9	37.9	18.9
1902	71.0	91.2	93.9	89.3	68.2	78.5	81.1	88.5	63.4	71.2	....	96.3	79.0	100.0	70.1	113.3	48.4	22.4
1903	73.9	96.6	91.1	94.2	86.7	80.6	85.3	78.8	58.8	69.6	....	106.2	82.9	99.1	82.0	105.6	54.8	30.1
1904	76.2	94.6	96.3	93.5	77.7	76.6	79.9	81.3	84.2	64.4	96.6	100.6	85.6	102.3	86.4	90.5	64.0	41.7
1905	96.6	100.2	103.1	102.8	82.6	87.1	93.9	88.5	78.8	89.4	97.8	110.7	87.8	95.8	94.2	110.1	73.6	55.3
1906	94.3	102.0	104.4	105.7	88.7	93.8	85.6	82.3	75.6	98.8	103.3	109.1	97.1	117.6	103.8	98.9	69.0	72.9
1907	73.5	104.4	106.1	95.9	96.6	95.6	87.0	86.1	71.6	101.1	103.3	126.3	104.0	78.5	108.8	100.0	90.7	89.7
1908	79.5	96.1	124.1	95.6	89.9	86.5	72.9	83.8	80.8	61.7	94.4	95.2	104.3	112.3	85.8	99.8	97.5	67.2
1909	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1910	88.9	99.2	80.7	120.2	102.3	91.5	102.6	74.5	102.3	105.8	100.0	117.0	105.6	125.6	86.0	49.2	114.4	114.1
1911	83.6	93.9	108.2	131.5	99.2	90.6	78.5	77.3	105.5	91.4	96.6	131.4	112.4	150.5	92.1	74.9	120.3	125.4
1912	96.6	87.7	107.3	133.6	107.9	103.9	88.9	110.2	119.8	114.2	101.1	133.5	110.4	140.1	121.7	108.6	121.7	177.7
1913	94.4	86.0	108.2	136.5	112.4	112.8	86.1	106.8	138.2	119.0	98.9	138.9	116.0	148.3	111.6	69.0	135.6	203.3
1914	102.5	78.2	99.2	129.0	120.4	114.3	94.6	107.8	124.6	90.2	91.0	130.8	117.4	176.8	122.1	53.2	145.0	179.4
1915	116.9	86.7	114.2	108.5	125.0	117.1	102.8	107.2	150.4	114.8	85.4	99.0	106.2	128.5	161.6	54.3	153.5	225.0
1916	66.1	101.4	137.6	113.2	130.7	141.0	143.2	134.4	165.6	150.3	89.9	186.6	104.1	137.0	155.0	55.3	164.0	304.9
1917	78.1	122.3	113.7	97.4	131.9	148.6	114.2	109.0	175.7	146.8	80.9	208.1	108.0	130.0	160.7	35.5	183.0	358.8
1918	113.0	140.8	138.2	117.3	117.6	145.3	115.5	104.2	197.2	149.7	71.9	129.9	89.3	137.0	155.1	51.7	194.2	415.7
1919	105.6	132.3	137.2	139.2	133.4	121.0	125.6	89.2	224.6	118.9	76.4	74.2	49.2	127.8	166.0	34.5	206.0	402.4

* Figures are for fiscal years ending June 30.

mobile Chamber of Commerce. The specific source from which each series is obtained is indicated in the section which follows.

(b) *The Individual Series*

GROUP I

Slaughtering and Meat Packing: The three live-stock series, showing receipts of *cattle, hogs, and sheep* at seven principal markets, are taken from the 1919 *Yearbook* of the Department of Agriculture. The figures from 1899 to 1909 were first made generally available in the *Monthly Summary of Foreign Commerce.* The series since 1910 is readily compiled from the official reports of the stockyards of the various cities.

Flour-mill and Gristmill Products: The *wheat* consumption series is a combination of data from two different sources. Wheat production data are secured from the *Yearbook* of the United States Department of Agriculture, and statistics of imports and exports of wheat from the December issues of the *Monthly Summary of Foreign Commerce.*

Beet Sugar; Cane Sugar Refining: The *sugar* production series combines beet sugar and cane sugar production in continental United States and imports of sugar. The data are taken from the *Yearbooks* of the Department of Agriculture and the *Statistical Abstract* for 1919.

GROUP II

Cotton Manufactures; Hosiery and Knit Goods: The data on *cotton* consumption are drawn from the Bulletins of the United States Bureau of the Census. The reports of Latham Alexander Co. constitute the original source of the series from 1899 to 1904. From 1904 to 1919 the figures are based upon returns made to the Census Bureau by individual manufacturers. Practically all establishments using raw cotton are covered.

Silk Goods, Including Throwsters: The series of *unmanufactured silk* imports is transcribed from the December issues of the *Monthly Summary of Foreign Commerce.*

Woolen and Worsted Goods; Carpets and Rugs, Other Than Rag: The *wool* consumption series is taken from the *Annual Wool Review* of the National Association of Wool Manufacturers.

Cordage and Twine and Jute and Linen Goods: The series showing imports of *unmanufactured fibers and textile grasses* is taken directly from the December issues of the *Monthly Summary of Foreign Commerce.*

TABLE XXII. — RELATIVE ANNUAL SERIES INDICATIVE OF PHYSICAL PRODUCTION FOR GROUPS OF MANUFACTURES, 1899–1919

(*Base: items for 1909 = 100*)

Year	IX. STONE, CLAY AND GLASS PRODUCTS				X. METALS AND METAL PRODUCTS OTHER THAN IRON AND STEEL					XI. TOBACCO MANUFACTURES			XII. VEHICLES FOR LAND TRANSPORTATION			
													STEAM RAILROAD CARS		AUTOMOBILES	
	Cement (Portland), production	Lime, burned and sold in U. S. production	Glass sand, production	Clay (raw), production	Copper, apparent consumption	Zinc, (primary) apparent consumption	Lead (primary), apparent consumption	Gold, used in manufactures and arts	Silver, used in manufactures and arts	Tobacco and snuff, production	Cigars,† production	Cigarettes,‡ production	Freight cars, production	Passenger cars, production	Passenger automobiles, production	Auto trucks, production
	million bbls.	*thous. sh. tons*	*thous. sh. tons*	*thous. sh. tons*	*million lbs.*	*thous. sh. tons*	*thous. sh. tons*	*thous. fine oz.*	*million fine oz.*	*million lbs.*	*billion cigars*	*billion cigarettes*	*thous. cars*	*one car*	*thous. cars*	*thous. cars*
1909	**64.99**	**3485**	**1104**	**2160**	**689**	**270.7**	**368.7**	**1820**	**27.90**	**431.4**	**6.668**	**6.82**	**86.9**	**2749**	**128**	**3.3**
1899	8.7	55.7	....	39.0	....	46.0	61.4	52.7	43.5	68.3	73.6	54.9	138.1	47.5	2.9	3.1
1900	13.1	54.2	....	56.6	51.8	36.7	73.0	58.8	47.4	69.7	83.5	47.6	133.1	59.5	....	....
1901	19.6	65.4	....	63.3	55.6	52.3	73.7	63.4	50.6	72.6	92.1	39.9	157.7	74.8	....	....
1902	26.5	74.4	85.4	67.3	80.1	56.4	90.2	73.5	69.4	80.5	93.6	43.4	187.2	70.9	....	....
1903	34.4	73.8	74.6	76.0	76.4	57.0	81.4	77.2	71.6	81.4	102.1	49.2	176.0	73.0	....	....
1904	40.8	77.7	77.8	69.8	70.0	66.8	86.7	76.2	73.4	82.0	99.6	50.2	70.0	78.0	16.7	12.6
1905	54.2	85.6	96.0	83.6	84.4	74.0	94.1	88.2	85.0	85.1	101.2	53.7	188.0	91.0	....	....
1906	71.5	91.8	98.6	93.8	98.4	81.6	102.1	104.0	78.3	90.6	107.1	66.0	268.8	112.2	....	....
1907	75.0	88.8	107.5	101.1	70.8	83.9	97.8	108.2	87.4	89.8	109.6	77.0	316.7	194.7	....	....
1908	78.6	79.4	99.1	79.8	69.7	79.1	86.4	83.6	85.5	94.5	97.3	84.2	78.3	59.6	....	....
1909	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1910	117.7	100.7	132.3	110.5	106.3	90.8	102.8	111.0	88.8	103.6	102.1	126.8	196.7	155.9	141.7	....
1911	120.8	97.4	139.4	101.0	99.0	103.5	104.4	108.5	114.7	98.5	105.6	153.3	71.6	126.0	156.0	327.0
1912	126.9	101.3	132.7	117.1	109.8	125.7	105.2	116.9	107.3	100.9	105.6	193.0	164.0	107.7	278.7	674.8
1913	141.7	103.2	162.3	122.5	117.9	109.1	113.8	121.9	111.0	103.0	113.6	228.0	213.8	101.0	361.3	720.9
1914	135.7	97.1	146.8	102.3	90.1	110.5	121.8	120.9	105.1	102.2	107.6	247.2	112.9	122.3	425.7	778.5
1915	132.2	104.0	170.6	109.3	151.5	134.7	115.4	100.5	107.3	102.5	99.0	263.2	80.8	67.9	641.0	2269.6
1916	140.8	116.9	182.7	135.8	207.7	169.3	129.5	135.7	115.0	108.0	105.6	370.1	149.0	65.6	1169.4	2760.2
1917	142.8	108.7	176.0	144.1	191.0	152.8	139.2	140.7	97.0	112.0	113.4	517.5	160.8	71.1	1362.8	3931.0
1918	109.3	92.0	196.8	137.8	241.3	156.4	133.8	139.5	130.0	115.1	104.9	555.7	124.4	57.2	725.3	6970.0
1919	123.5	85.4	153.1	109.4	168.3	112.3	123.7	188.6	....	99.7	102.9	657.0	180.5	14.2	1298.0	9710.0

† Weighing more than 3 pounds per thousand. ‡ Weighing not more than 3 pounds per thousand.

GROUP III

The figures of approximate consumption of *pig iron* are available for years since 1871 in the annual reports of the American Iron and Steel Institute (formerly the American Iron and Steel Association).

GROUP IV

The series giving the estimated yearly cut of *lumber* in the United States is taken from Bulletins 673 and 845 of the Department of Agriculture. These two bulletins were compiled by statisticians of the United States Forest Service.

GROUP VII

Liquors, Distilled; Liquors, Malt: The two series giving total quantity of *distilled spirits* and *fermented liquors* produced in the United States are both taken from the reports of the Commissioner of Internal Revenue.

GROUP VIII

The five series of this group are taken from a number of independent sources. The two series of *by-product coke* and *crude petroleum* production come from Part II of the annual report of the United States Geological Survey on *Mineral Resources.* Part I of this report yields the series giving the production of *zinc and lead pigments.* The *flaxseed* series is taken from the 1903 *Statistical Abstract* for the period up to 1901, and from the *Yearbook* of the Department of Agriculture from the period 1902 to date. The data on *cottonseed* consumption are obtained from the Bulletins of the United States Bureau of the Census on the *Production and Distribution of Cotton.*

GROUP IX

The three series of this group, showing the production of *raw clay, glass sand, and lime,* are all taken from Part II of the Geological Survey's report on *Mineral Resources.*

GROUP X

The data on the consumption of *gold* and *silver* in manufactures and the arts are obtained from the annual reports of the United States Director of the Mint. The other three series of this group — those of the apparent consumption of *copper, lead,* and *zinc* — are drawn from Part I of the Geological Survey's report on *Mineral Resources.*

GROUP XI

The three series recording the production of *tobacco and snuff*, *cigars*, *and cigarettes*, are secured from the annual reports of the Commissioner of Internal Revenue.

GROUP XII

Data on the production of *passenger cars* and *freight cars* are published regularly in the *Railway Age*. The figures as published for the period 1905–12 include, however, production in Canada as well as in the United States. The series excluding Canadian output have been kindly furnished by Mr. C. N. Foss, present associate editor of *Railway Age*. The two series giving the production of *passenger automobiles* and *motor trucks* are taken from *Facts and Figures of the Automobile Industry*, a 1920 publication of the National Automobile Chamber of Commerce.

The thirty-three annual series, obtained from these numerous sources, are given in full in Table XXI. They are plotted with their individual lines of secular trend, in Charts XXI, XXII, and XXIII.

METHODS EMPLOYED

The methods employed in constructing the index based upon annual data do not differ substantially from those used in earlier sections of this study of the physical volume of production. As before, the first step consists in the reduction of the original items of the several series to percentages of the items of the base period — in this case the year 1909. The unadjusted index for manufacture, like the indices for agriculture and mining, is a weighted geometric mean of these percentage relatives.

In the construction of the manufacturing index, however, certain steps are involved which were not necessary in the development of the indices of agriculture and mining. These steps have already been explained in obtaining the manufacturing index based upon census data. In general, they consist of a systematic grouping of the original series with careful regard to the census classification of manufacturing industries, and the subsequent adoption of weights corresponding consistently to the level upon which the individual series stand in the hierarchy of single commodity lines, individual industries, groups of industries, and manufacturing as a whole.

The grouping of the series has already been dealt with in the analysis of census data. Among the annual, as among the census data, some series present single commodities important in individual industries. Thus receipts of cattle, hogs, and sheep at seven important interior markets reflect the activity of the slaughtering and meat-packing industry. Such series have to be grouped under the industry to which they particularly relate. Other individual series serve to register changes in the output of entire industries; still others, fluctuations in the physical volume of production in whole groups of industries. The systematic grouping of the original series is one of the essential steps in the development of the manufacturing index.

The selection of weights in the construction of the manufacturing index follows directly from the classification of the original series. The weighting of series is by cost or value and of industries by value added by manufacture in 1909. There are, however, three distinct orders of weights on this general principle. In the first place, there are the weights assigned to series reflecting particular lines in single industries. In the second place, there are the weights applied to series assumed to represent the outputs of entire industries. And finally, there are the weights corresponding to the value added by manufacture in important groups of manufacturing industries. As previously pointed out, the index for manufacture is the result of a process of integration. This process depends upon the careful classification of the original series and the adoption of weights registering the different levels of importance of the series and relatives as they are made to represent specific lines of recognized industries, whole industries, or entire groups of industries.

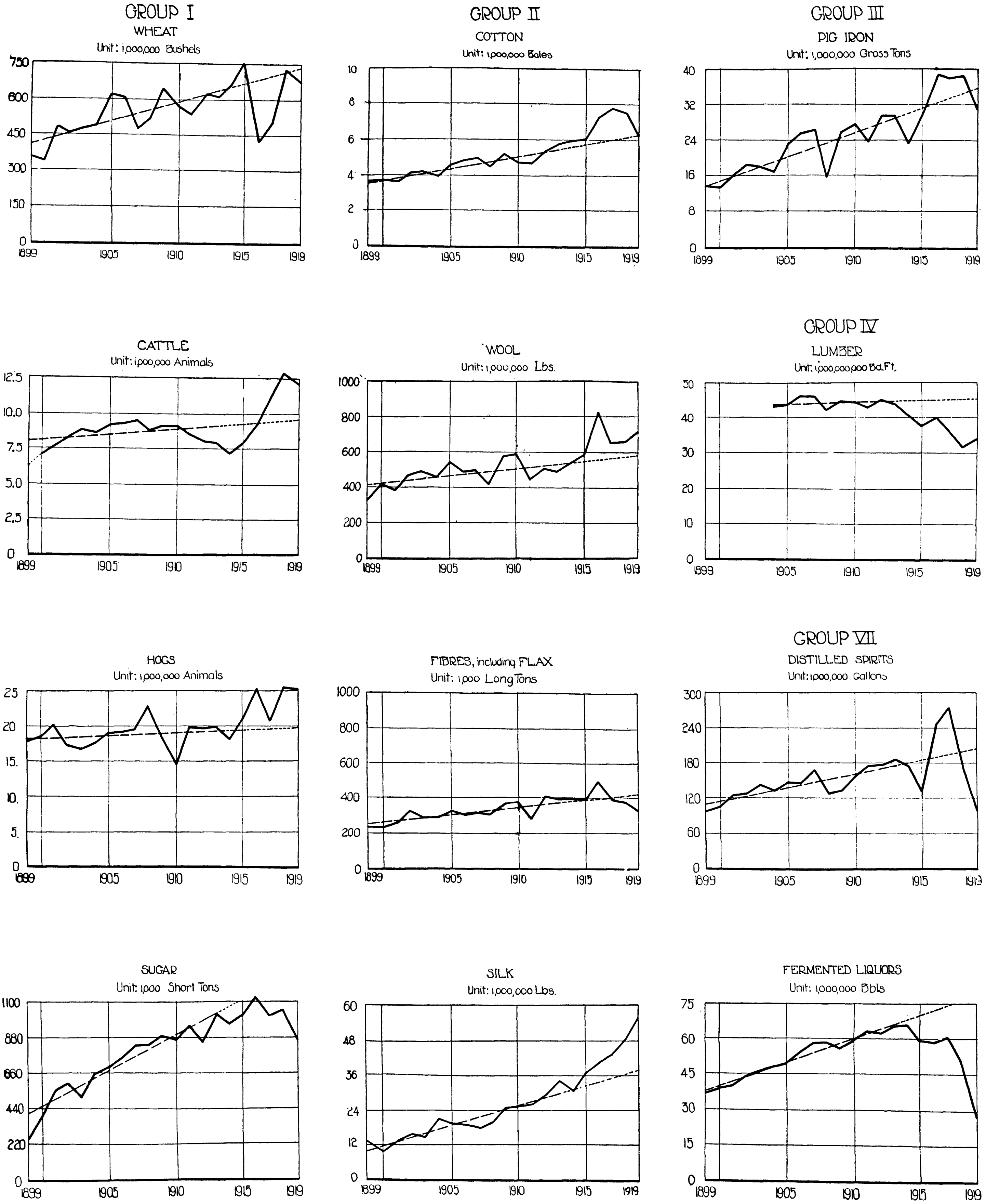
THE ANNUAL UNADJUSTED INDEX

The first step in the construction of the annual unadjusted index is the reduction of the original items of the thirty-three adopted series to percentages of the items of the base year 1909. The results of this simple operation appear in Table XXII.

The weights used in obtaining the unadjusted index from the thirty-three series of percentage relatives are the weights derived from the analysis of the data of the manufacturing census of 1909. These weights all appear in Table A of the analysis of census data. They are used in the construction of the annual index precisely as they were used in the development of the index based upon census data.

With these weights in hand it is comparatively easy to obtain unadjusted indices of the physical volume of production for the groups of manufacturing industries recognized in the census classification. Some of these group indices rest upon as many as five individual-industry indices. These indices for individual industries may in turn consist of weighted geometric means of series of percentage relatives for individual commodities. Upon the other hand, the first averaging within a manufacturing group may be in the combination of the several industries to obtain the group index. Examination of the character of the original series upon which the annual unadjusted index is based, will indicate clearly enough the manner in which the group indices are derived.

These group indices appear in Table XXIII together with the corresponding indices based primarily upon census data. It is to be noted that no indices are offered for Groups VI, VII, XIII, and XIV — the groups of industries appearing in the census classification under the designations of leather and its products, paper and printing, railroad repair shops, and miscellaneous industries. No serviceable annual data on physical production are available for these groups. For two or



The plot is of sugar produced from beets and cane grown in continental United States.

CHART XXI. — ANNUAL SERIES INDICATIVE OF MANUFACTURE OF FOOD, TEXTILES, IRON AND STEEL, LUMBER, AND LIQUORS, 1899–1919, TOGETHER WITH LINES OF SECULAR TREND.

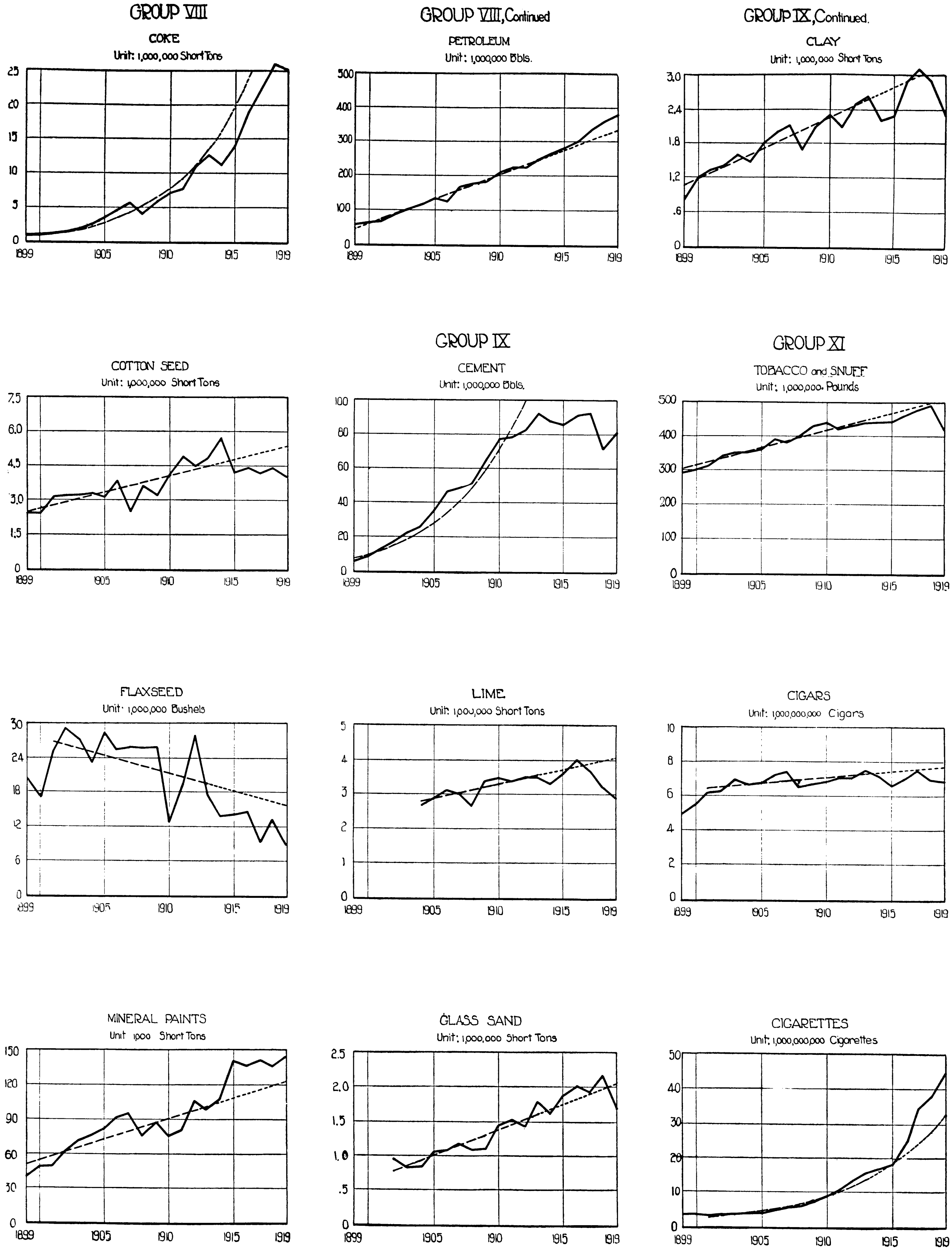


Chart XXII. — Annual Series Indicative of Manufacture of Chemicals, Stone and Clay Products, and Tobacco, 1899–1919, together with Lines of Secular Trend

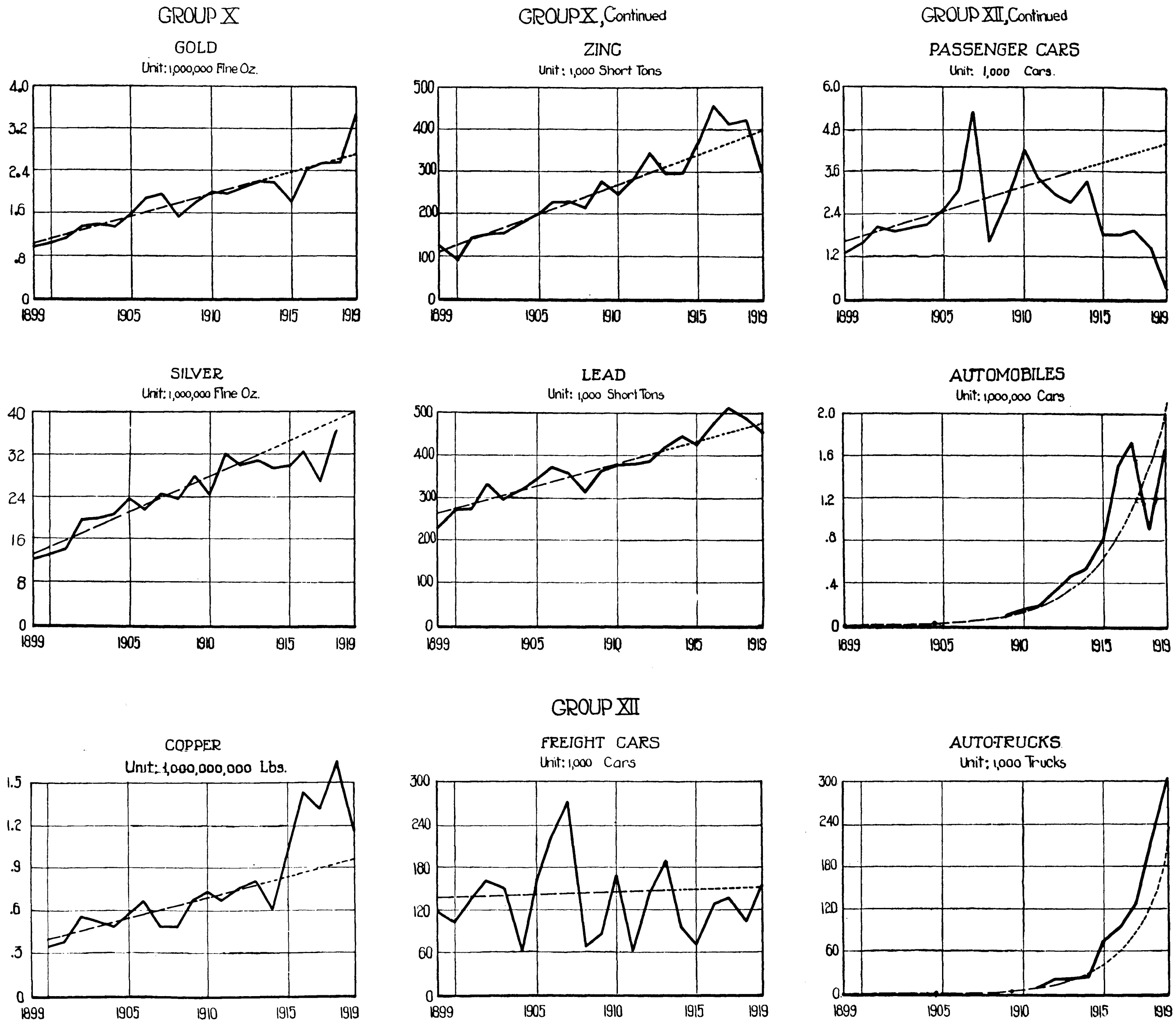


Chart XXIII. — Annual Series Indicative of Manufacture of Metals other than Iron and Steel, and Vehicles, 1899–1919, together with Lines of Secular Trend

three of the other groups the annual data are slight, but not so deficient as to forbid the computation of group indices.

The construction of the unadjusted index based upon annual data involves a correction of the group indices to make them conform to the corresponding group indices based upon census returns. Of course, for the base year 1909 the group indices are 100 in all cases whether based upon annual or census series. For other census years the group indices based upon annual data deviate in varying degrees from the corresponding group indices based upon census data. Presumably, the census indices are the more trustworthy, for reasons already discussed. Consequently the group indices based upon annual items are "corrected" to equal the indices based upon census data for the census years 1899, 1904, and 1914. Proportionate corrections are made, of course, for all non-census years.[1]

The corrected annual group indices appear in Table XXIII. It will be observed that the corrections do not substantially modify the majority of the indices. In two or three cases, however, the changes are considerable. For these groups the annual data are presumably an inadequate representation of the groups as a whole. Despite this fact, however, the year to year fluctuations of the annual indices probably reflect accurately the relative year to year activity of the groups. If this be the case, the annual group indices, having been corrected so as to bring them to the level of the indices for census years, constitute a satisfactory register of the physical volume of production in the groups of manufacturing industries for which they stand.

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[1] The corrections are made by adjusting the logarithms of the annual indices. These adjustments are effected as follows: The difference between the logarithms of the census and annual indices at one census year is algebraically subtracted from the corresponding difference at the next census year. The number obtained by this subtraction is then divided by five and the resulting increment applied as a correction to the logarithms of the indices of the intercensal years. For the years from 1915 to 1919 the same logarithmic corrective is applied as for the year 1914.

TABLE XXIII. — GROUP INDICES OF PHYSICAL PRODUCTION FOR MANUFACTURE FOR CENSUS YEARS BASED ON (*a*) UNCORRECTED ANNUAL DATA; (*b*) CENSUS DATA.

Groups	1899		1904		1909		1914	
	Annual	Census	Annual	Census	Annual	Census	Annual	Census
All Groups covered	54.6	61.2	74.2	75.4	100.0	100.0	106.6	104.9
I. Food	68.5	69.3	85.2	86.6	100.0	100.0	98.6	105.8
II. Textiles	64.0	67.0	78.7	77.6	100.0	100.0	109.8	105.4
III. Iron and steel	53.2	58.2	64.4	70.1	100.0	100.0	90.2	93.9
IV. Lumber	78.8	79.2	96.6	71.8	100.0	100.0	91.0	80.6
VII. Liquors	65.6	65.4	86.8	86.7	100.0	100.0	118.6	118.4
VIII. Chemicals	39.7	50.2	71.9	73.5	100.0	100.0	130.5	119.9
IX. Stone, clay	51.9	71.1	76.2	84.2	100.0	100.0	100.6	103.8
X. Metals, non-ferrous	51.9	51.9	73.4	73.4	100.0	100.0	104.0	104.0
XI. Tobacco	69.6	69.6	86.9	86.9	100.0	100.0	114.7	114.7
XII. Vehicles	11.6	28.2	28.6	52.6	100.0	100.0	263.2	185.5

The several annual group indices having been corrected, the final step in the construction of the index for manufacture is the computation of a weighted geometric mean of the group indices. The weights employed are those determined in the analysis of the census data, and correspond to the values added by manufacture in the several groups of industries represented by the annual data. The resulting index of the physical volume of production for manufacture is continuous by years from 1899 to 1919, and for census years is very close to the index based upon census data. It is not exactly equal to the latter, however, for the reason that two groups of industries included in the census data are entirely unrepresented among the annual series. The slight discrepancy which results from this fact is removed by a final correction (effected by the same method as used in adjusting the group indices) making the annual index for census years conform exactly to the index based upon census data.

TABLE XXIV. — UNADJUSTED INDEX OF PHYSICAL PRODUCTION FOR MANUFACTURE, 1899–1919

Year	Index based upon corrected group indices *Item for 1909 = 100*	Index after final correction *Item for 1909 = 100*	Index after final correction *Average for 1909–13 = 100*
1899	61.8	**61.2**	58.4
1900	62.2	61.8	59.0
1901	69.1	68.8	65.6
1902	75.8	75.6	72.1
1903	76.7	76.8	73.3
1904	75.1	**75.4**	71.9
1905	88.1	88.4	84.3
1906	94.6	94.9	90.5
1907	95.5	95.7	91.3
1908	81.1	81.2	77.5
1909	100.0	**100.0**	95.4
1910	101.3	101.6	96.9
1911	96.4	96.9	92.4
1912	110.2	111.0	105.9
1913	113.4	114.5	109.2
1914	103.6	**104.9**	100.1
1915	113.2	114.6	109.3
1916	132.2	133.8	127.7
1917	130.1	131.7	125.6
1918	129.4	131.0	125.0
1919	118.0	119.5	114.0

The index for manufacture (1) as obtained from the corrected group indices, and (2) after its final correction, is presented in Table XXIV. Throughout the computations of the manufacturing index, the base period is the year 1909. The indices for agriculture and mining upon the other hand, were set up with the average of the period 1909–13 as a base. To make comparison of the three indices perfectly simple and direct, the manufacturing index is transposed to the same five-year base. The index upon this base is also given in Table

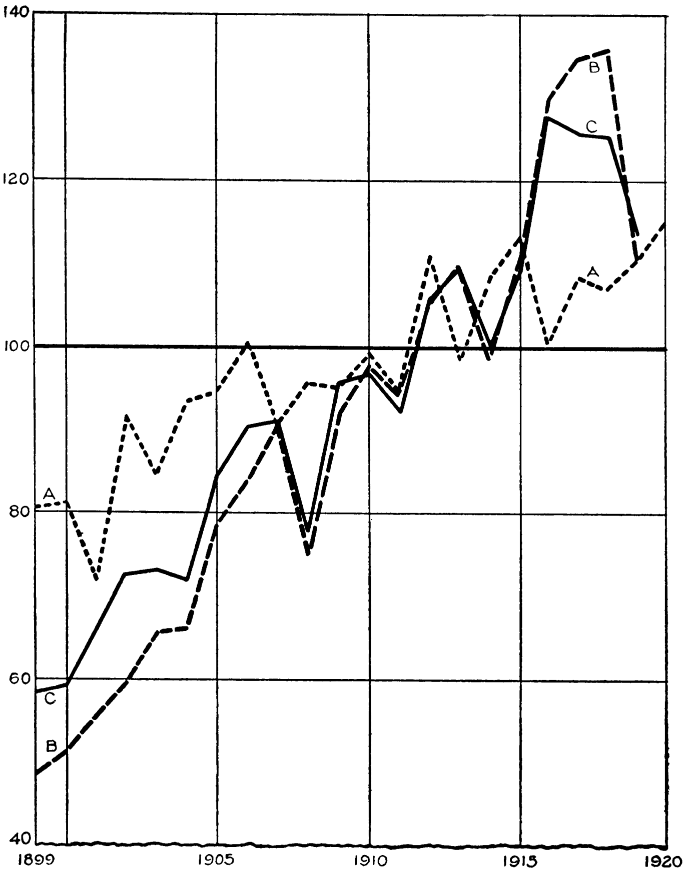

CHART XXIV. — UNADJUSTED INDEX OF PHYSICAL PRODUCTION FOR (A) AGRICULTURE, 1899–1920; (B) MINING, 1899–1919; (C) MANUFACTURE, 1899–1919.

(*Arithmetic average for 1909–13 = 100*)

XXIV. It is shown graphically, together with the indices for agriculture and mining, in Chart XXIV.

Examination of the manufacturing index, as thus presented, discloses marked fluctuations in the physical volume of production. Manufacturing output was relatively low in 1904, 1908, 1911, and 1914. It was relatively high in 1902, 1905–07, 1909–10, 1912–13, and 1916–18. The fluctuations of manufacturing output appear to be much more cyclical than the variations of agricultural production. In general, the fluctuations of production in manufacture resemble closely those in mining.

In Table XXV and Chart XXV, the unadjusted index of physical production for manufacture is compared with corresponding indices for agriculture, mining, and the population of continental United States. To facilitate comparison, all of the indices are reduced to the base of 1899 = 100. In general, the increase of the physical volume of production in manufacture from 1899 to 1919, lies about half way between the much smaller increase of agricultural output and the substantially greater increase of production in mining. During the twenty-year period preceding 1919, population and agricultural output both increased less than one-half; production in manufacturing practically doubled; and mineral production increased between two- and threefold. The similarity of the fluctuations in manufacture and mining is strikingly shown in Chart XXV, and the contrast between manufacture and agriculture is as sharply drawn as was the contrast between mining and agriculture in the analysis of Part II. Comparison of the indices invites further analysis of the year-to-year fluctuations of the physical volume of production in manufacture. This will be undertaken in the development of the adjusted index for manufacture in the December issue of the REVIEW.

TABLE XXV. — UNADJUSTED INDEX OF PHYSICAL PRODUCTION FOR MANUFACTURE, COMPARED WITH CORRESPONDING INDICES FOR AGRICULTURE, MINING AND POPULATION, 1899–1919.

(Items for 1899 = 100)

Year	Population	Index for population	Index for agriculture	Index for mining	Index for manufacture
	(millions)				
1899	74.69	100.0	100.0	100.0	100.0
1900	75.99	101.8	100.6	105.7	101.0
1901	77.59	103.8	89.3	114.6	112.4
1902	79.19	106.0	113.7	122.7	123.5
1903	80.79	108.1	105.0	135.0	125.5
1904	82.39	110.3	116.0	136.3	123.2
1905	83.98	112.4	117.5	161.6	144.4
1906	85.58	114.5	125.0	169.9	155.0
1907	87.18	116.7	112.4	185.9	156.3
1908	88.78	118.9	118.8	154.2	132.7
1909	90.37	121.0	118.1	189.4	163.4
1910	91.97	123.1	123.2	201.6	166.0
1911	93.57	125.3	117.0	194.4	158.3
1912	95.17	127.4	138.1	216.7	181.4
1913	96.77	129.6	122.1	227.2	187.1
1914	98.36	131.6	135.0	202.6	171.4
1915	99.58	133.2	141.0	227.6	187.2
1916	100.80	134.8	124.9	267.0	218.6
1917	102.02	136.5	135.0	277.2	215.2
1918	103.24	138.1	133.2	279.6	214.0
1919	104.46	139.7	137.6	228.4	195.3

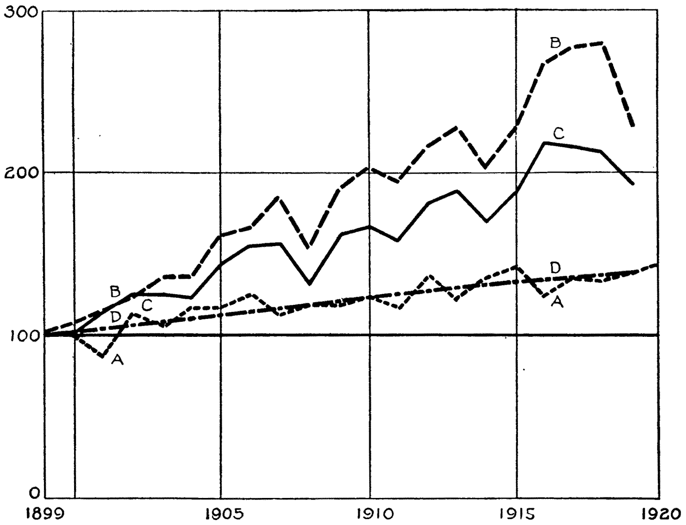

CHART XXV. — UNADJUSTED INDICES OF PHYSICAL PRODUCTION FOR (A) AGRICULTURE, 1899–1920, (B) MINING, 1899–1919, (C) MANUFACTURE, 1899–1919, (D) POPULATION, 1899–1919.

(Items for 1899 = 100)